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POLLUTION OF THE INTERSTATE WATERS OF THE LOWER MISSISSIPPI RIVER. PROCEEDINGS OF CONFERENCE HELD AT NEW ORLEANS, LOUISIANA ON MAY 5-6, 1964. VOLUME II

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6 May 1964

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CONFERENCE

in the matter of

Pollution of the Interstate Waters of the

LOWER MISSISSIPPI RIVER

PROCEEDINGS

Volume II

May 5-6, 1964
New Orleans, Louisiana

U.S. Department of Health, Education, and Welfare
Washington, D.C.

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AFTERNOON SESSION

(1:45 p.m.)

MR. STEIN: May we reconvene?

Mr. Svore?

MR. SVORE: Mr. Chairman, I would now like to call on Dr. Alfred Grzenda, Assistant Chief, Pesticide Pollution Studies, of Atlanta, Georgia, who will discuss the investigation of insecticide pollution in the vicinity of Memphis, Tennessee.

Dr. Grzenda.

STATEMENT OF DR. ALFRED R. GRZENDA, ASSISTANT CHIEF, PESTICIDE POLLUTION STUDIES, UNITED STATES PUBLIC HEALTH SERVICE, ATLANTA, GEORGIA

DR. GRZENDA: Mr. Chairman, conferees, ladies and gentlemen:

This report is a summary of the observations, interviews, and data obtained from samples collected on field trips made by me, Dr. Jerry Lauer, and Mr. Quentin Stober of the Region IV office, to Memphis, Tennessee, and vicinity, on April 4-5, 8-11, 15-17, and 21-25, 1964. The purpose of these trips was to investigate insecticide contamination in the streams, rivers, and sewers in the vicinity of Memphis. Much of this work, but not all, centered around the Velsicol Chemical Corporation plant located at 1199 Warford Street, Memphis, Tennessee.

THE VELSICOL PLANT

On 23 April, Mr. John Fairall, a chemical engineering consultant from the Taft Center, and I were granted an interview with Mr. William Anthony, the plant manager. According to Mr. Anthony, Velsicol's installation at Memphis consists of four distinct plants which manufacture caustic chlorine, hexachlorcyclopentadiene (PCL), heptachlor and Endrin, respectively. Endrin manufacture was initiated in 1955. Bandane, a herbicide, is occasionally made in the heptachlor plant. Virtually no information was given about the various processes involved in the manufacture of these products. When we asked specific questions about starting and intermediate products, Mr. Anthony referred us to the patents for the manufacture of these compounds. Mr. Anthony took us to the plant's waste treatment facility on 23 April and we made arrangements to obtain samples the following day. On 24 April, we were assisted in collecting waste samples by Messrs. Charles Hansen and Harry Scarborough of the Velsicol Chemical Corporation.

A. R. Grzenda

WASTE TREATMENT AND SEWAGE SYSTEMS

Mr. Anthony said all process wastes except those hauled to a dump pass through the plant's treatment facility. This facility consists of a 50-ton lime bed used to produce a lime slurry which is added to a 40,000-gallon agitated retention tank. Retention time in the tank varies from 15 to 20 minutes and is used to regulate pH before the wastes are discharged into the sewer. A Parshall Flume, designed for a maximum flow of 4,000 gallons per minute, measures the effluent from the agitation tank. Mr. Anthony indicated that there were virtually no solids in the wastes entering the agitation tank. However, sludge was dredged from the sides and middle of the tank and it contained a black, sticky, smelly residue. In the course of sampling, I splashed sludge on my face. It was extremely irritating to my eyes and skin.

Mr. Anthony said the treatment plant has been in operation since 4 June, 1963, upon completion of a trade waste and interceptor sewer which discharges into the Mississippi River. Prior to this time, Velsicol discharged process wastes into Cypress Creek.

Now, if I may have the first slide, please?

This slide (indicating) will give you a general picture of the area. It is generally not drawn to scale.

In the upper right-hand corner we have the Velsicol plant.

This Parshall Flume that we sampled was located on plant grounds. Memphis is bounded on the north by the Wolf River, which flows into the Mississippi. Above the Wolf River confluence, we have the Lossahatchie River confluence, and again on the south, Memphis is bounded by Nonconnah Creek, which flows into McKellar Lake, which flows into Tennessee Chute, which is contiguous with the Mississippi River.

Now, the area we are concerned with now is Cypress Creek in the vicinity of the Velsicol plant.

Mr. Anthony said that the processes for the manufacture of Endrin are continuous and were in operation when Mr. Fairall and I sampled the flume on 24 April. However, Mr. Everett Handorf, Engineer-Director of the Bureau of Sanitary Engineering, Memphis-Shelby County Health Department, said that there are batch discharges associated with the manufacture of Endrin.

The reports which I and other Public Health Service investigators received about the sewer system in the vicinity of the Velsicol plant are contradictory. In the railroad yard adjacent to the Velsicol plant, there is a 36-inch sewer line on the east side of the railroad tracks and a 48-inch line on the west side of the tracks. On 5 April and again on 9 April, Mr. Jimmy Chaney, a sanitary engineer with the Memphis-Shelby County Health Department, described the 36-inch line as a trade waste sewer from Velsicol which eventually ties into the 48-inch line. On the basis of this information, sludge and liquid samples were collected from the 36-inch line on 5 April. On 9 April, I met in Memphis with Messrs. Victor Jelin, Thomas Neuman, Thomas Gallagher, and Robert McCullough, all from the Taft Center, to obtain additional samples and discharge measurements from the sewers in the railroad yards adjacent to the Velsicol plant. When we arrived in the railroad yard, we met Mr. Maxson, the Memphis City Engineer. He was in the area to check for leaks in the sewer lines and mentioned that a public works crew had detonated smoke bombs in several of the manholes. Mr. Maxson also expressed confusion about the origin of the various sewer lines. When Mr. Jelin and I lifted manhole covers on the 36- and 48-inch lines, smoke poured out making sampling impossible. On 9 and 10 April, Mr. Jelin and crew obtained a series of discharge measurements from a 24-inch cooling water outfall discharging into Cypress Creek. On 10 April, single discharge measurements were obtained from two points on the 36-inch line and from a drop manhole on the 48-inch line.

It was discovered that the manhole on the 36-inch line adjacent to the Velsicol plant (this is the one previously sampled on 5 April) had an 8-inch sewer line discharging into it. Beneath the 8-inch line there was a hard crust of material which also contained some unhardened sludge. The crust was deposited around the entire circumference of a manhole and virtually obliterated view of the effluent in the bottom of the manhole.

Mr. Jelin had planned to descend into the manhole on the 36-inch sewer to obtain discharge measurements. However, I had cautioned him that this might be extremely dangerous because of noxious fumes and residues. After we lifted the manhole cover, he was in full agreement and did not enter the sewer. This is the same site that Mr. Anthony later described (23 April) as a sanitary sewer. Later that day, Mr. Jelin opened the manhole on a 48-inch drop sewer. The same strong chemical odor noted in the 36-inch sewer was also present in the drop manhole. In Mr. Jelin's opinion, the 36-inch line was the trade waste sewer and the 48-inch line a city sanitary sewer which also receives Velsicol wastes in the vicinity of the plant.

On 23 April, John Fairall and I spoke briefly with Mr. Anthony. Mr. Anthony stated that the 48-inch line was the trade waste sewer and the 36-inch line the city sanitary sewer. He indicated that all of Velsicol's process wastes (except those hauled to the Hollywood Dump -- and again this is located on Wolf Creek, which is known as the Hollywood Dump--) are discharged into the 48-inch line on the west side of the railroad tracks. He denied any knowledge of the 8-inch sewer. Mr. Fairall and I accompanied Mr. Anthony to the railroad yard and showed him the 8-inch line. He indicated that this was probably a line which carried sanitary wastes from the Velsicol plant. I inquired why sanitary sewage had had a strong chemical odor similar to that noted at the Parshall Flume. These odors were noted by me on 5 and 9-10 April and were not present on 23 April when Mr. Anthony visited the site. He mentioned the possibility of yard drainage and ruptured sewer lines on the Velsicol property. Mr. Fairall and I, upon inspecting the sewer system and the lay-of-the-land, agreed with Mr. Anthony that the retention tank effluent was being discharged into the 48-inch drop sewer mentioned by Mr. Jelin.

On 27 April, Mr. David Crapps, an engineer from the Region IV office, left for Memphis to obtain additional samples and discharge measurements from the trade waste sewer in the vicinity of the sewage pumping station on Peres Street. The industrial sewage is pumped into the interceptor from this station. Since I had last visited this site there had been construction on the sewer line to remove a 90-degree bend.

Since the sampling site did not fit my description, Mr. Crapps requested information from the Memphis-Shelby County Bureau of Sanitary Engineering. Mr. Handorf sent Mr. Chaney to assist Mr. Crapps in defining this rather complicated sewage system. When Messrs. Chaney and Crapps visited the pumping station they discovered high discharge volumes in the 48-inch sewer. Unexpectedly, they also found a by-pass line which was discharging the trade wastes into a lake which flows into the Wolf River. Mr. Crapps estimated that about 1/4 of the sewage volume was flowing into this lake. Therefore, on occasion, the Wolf River still receives wastes from Velsicol and the other industries which tie into the trade waste sewer.

Samples were also collected from the old Velsicol outfall in Cypress Creek. Messrs. Anthony, Chaney, and Handorf all agreed that Velsicol had stopped discharging process wastes through this 24-inch outfall in June 1963. Similarly all agreed that non-process cooling waters are presently being discharged. Mr. Anthony denied there was any possibility that the outfall effluent might contain insecticides. However, Mr. Chaney indicated that the presence of Endrin was probable because of the residues which had accumulated on the sides of the sewer pipe. The samples collected from the cooling water outfall on 5, 9-10 April all had a strong chemical odor similar to that noted in the wastes obtained from the Velsicol agitation tank.

SOLID WASTES DISPOSAL

Mr. Handorf said that solid wastes in both drums and Dempster Dumpsters are being hauled from the Velsicol plant to a city dump. This facet of the investigation was carried out jointly by Mr. John Fairall of the Taft Center and Dr. Barthel, Chemist in Charge, Methods Improvement Laboratory, Plant Pest Control, United States Department of Agriculture, Gulfport, Mississippi. On 15 April 1964, Dr. Barthel and Mr. Fairall interviewed Mr. Lewis, Superintendent of the Hollywood Dump. Mr. Lewis reported that the Patterson Transfer Company had been hauling, on the average, 12 50-gallon drums of wastes per day from the Velsicol plant to the Hollywood Dump. This material is buried, partially buried, or left exposed on a portion of the dump located on the flood plain of the Wolf River. Mr. Lewis also identified the used, black, light-gage, caustic drums as being hauled from Velsicol. When I visited the dump, some of the barrels were in a water-filled trench which was contiguous to the Wolf River. Others were exposed on the ground. I took photographs of the drums on 15 April. When I re-visited the dump on 24 April, all the barrels I had photographed had been removed.

Mr. Fairall and Dr. Barthel also learned from Mr. Lewis that about six months ago a workman who was hauling drums from Velsicol became ill from contact with the wastes. Mr. Lewis described the wastes as being semi-liquid and capable of splashing on the workmen. After the accident, there was a three to four-month period when wastes were not hauled to the dump. After this period, 1,600 caustic drums were buried more or less simultaneously in the dump. Unlike the materials previously disposed of, these were principally solid or granular wastes. When Mr. Fairall and I interviewed Mr. Anthony on 24 April, he acknowledged that Velsicol is presently having from 6 to 10 drums of wastes hauled to the Hollywood Dump every 24-hour period. Also, according to Mr. Anthony, one Dempster Dumpster, generally about 2/3 full and measuring about 8x4x4 feet, is hauled to the Hollywood Dump every other day. Mr. Anthony said the drums contain still bottoms from the PCL plant and the Dumpsters filter-cake from the heptachlor plant. He denied that any solids from the Endrin plant were being hauled to the Hollywood Dump. However, Mr. Fairall and Dr. Barthel noted drums labeled "isodrin scraps" at the Hollywood Dump on 15 April. Isodrin is one of the compounds used in the manufacture of Endrin. However, Mr. Anthony said that such material is not normally taken to the Hollywood Dump for disposal.

I would like to show some pictures of the dump. This (indicating) is the Hollywood dump. It is an incongruous name, but that is what they call it in Memphis.

This (indicating) is that transient water which I described as being contiguous to the Wolf River.

Next slide, please.

Again, these (indicating) are the drums which Mr. Lewis identified as being the caustic drums originating from the Velsicol plant.

MR. STEIN: Are those the drums that you didn't see in the later visit?

DR. GRZENDA: Yes, sir.

This (indicating) is a close-up of the same scene. You will notice the surface of the water there has an icy appearance. This is crystalline material which had precipitated on the surface of the water. This material was sampled.

Next slide, please.

This (indicating) is a close-up of the same crystalline material which was at the surface of the water.

These (indicating) are close-ups of additional drums identified as coming from Velsicol. These were, as you can see, exposed and on the ground.

This (indicating) is more of the same. We collected material similar to that red residue that the stick is pointing at from the Velsicol plant with the aid of Mr. Scarborough.

There (indicating) are additional drums.

There (indicating) are more of the same.

This (indicating) is the label which identifies the barrel as a caustic drum, which Mr. Lewis described as coming from Velsicol.

MR. STEIN: Why don't you say something about all the pictures? Can we go back?

DR. GRZENDA: These (indicating) are all drums that were in the Hollywood dump located on the flood plain. All of the sites that were shown in the photographs are subject to flooding.

This (indicating) is the same barrel, just a different view.

DRUM RECLAMATION

In their investigations, Mr. Fariall and Dr. Barthel also spoke to Mr. Jehl of the Jehl Cooperage Company in Memphis, Tennessee. The Jehl Company reclaims drums which they acquire from various sources, including insecticide formulators. Up to about six months ago, insecticides were drained from such drums and disposed of in the South Bellevue Dump.

The South Belleview Dump is not in the drainage system associated with Velsicol. It is located in the lower left-hand corner of the slide on Nonconnah Creek (indicating).

You remember Nonconnah Creek flows into McKellar Lake to Tennessee Chute, to the Mississippi River, so we are out of the Velsicol drainage system now. We are in Nonconnah Creek in the south edge of town.

Since that time the Jehl Company has been using an incinerating process which alleviates the need for draining the drums. On the average, 1,000 drums are processed each month. The South Bellevue Dump is located on the banks of Nonconnah Creek. Whether other dumps along Nonconnah Creek receive or have received similar wastes is unknown.

THE DREDGING OF CYPRESS CREEK

Prior to June 1963, all of Velsicol wastes, with the exception of those hauled to the dump, were discharged into Cypress Creek, a tributary of the Wolf River flowing through residential areas in Memphis. There are approximately 3.3 stream miles between this outfall and the Wolf River. Since June 1963, this outfall has been discharging only cooling water into Cypress Creek. However, samples of sediment taken downstream from the Cypress Creek cooling water outfall contained a smelly, highly irritating, black, sticky residue similar to that present in the sludge obtained from the agitation tank in the Velsicol plant.

May I have Slide No. 2?

To refresh your memory on this, we have the cooling water outfall. That originates from Velsicol. We have Cypress Creek flowing in a northwest direction, and there is a levee and a pumping station there. The drainage in Cypress Creek is pumped over the levee into the Wolf River.

There are two stations that are of importance in the following discussion. That is the Meager Street Bridge. That is the first bridge. That is a bridge a half a mile downstream from the cooling water outfall, and the Hollywood Dump also figures prominently in this story. If you can keep a mental image of this in your mind, it would help.

MR. STEIN: Pardon me. They can't hear you in the back.

DR. GRZENDA: Excuse me.

The sites of importance in the following discussion are the Meager Street Bridge, which is a bridge located one-half a mile downstream from the Velsicol cooling water outfall; also the Hollywood Dump, which was shown in the slide just a few moments ago.

Cypress Creek is a concrete-lined ditch up to the Meager Street Bridge, which is about 0.5 miles downstream from the cooling water outfall. The creek had been partially dredged in the past and contained an exposed sediment bar extending from the outfall to the Meager Street Bridge (0.5 miles). The bar was roughly triangular in shape measuring approximately three feet in height and twenty feet at the base. On 15 April, Mr. Fairall and Dr. Barthel observed a public works crew from the City of Memphis trucking this material to the Hollywood Dump. When I arrived in Memphis on 15 April, roughly 150 linear yards of ditch-bottom had been cleared and taken to the dump. When I returned to Memphis on 21 April, the entire sediment bar which had extended from the outfall to the Meager Street Bridge, had been removed. Photographs were taken of the partially dredged channel and of the sediment trucked to the dump.

Again, this was a half a mile of sediment that was removed (indicating).

This (indicating) is a view from the Meager Street Bridge facing upstream to the Velsicol cooling outfall.

This (indicating) is the portion of the stream that had been dredged when I arrived in Memphis on April 15th. You can see the truck tracks on the concrete lining of the creek.

This (indicating) is upstream from the material that had been removed. This is what the channel looked like in the area from where the sediment had been hauled. The materials you are looking at were still in the stream on April 15th.

This (indicating) is a close-up of the materials of sediment which later was removed from the ditch channel. Notice the color of the sediment. It is black. It had the same type of highly odorous black residue which was noted in the agitation basin on the Velsicol property.

Again, this (indicating) is a view of the Hollywood Dump from the north bank of the Wolf River. The mounds of dirt that you see in the foreground (indicating) are the sediments which had been removed from Cypress Creek on the 15th of April. Note the close proximity of these sediments to the Wolf River. The water that you see in the background is the Wolf River.

Again (indicating), more sediments which had been removed from Cypress Creek.

This (indicating) is an additional view of sediments which had been viewed, removed from Cypress Creek.

Putting the last three slides together, they give a panoramic view of the extent of the sediment that had been removed.

This (indicating) again is sediment from Cypress Creek at the Hollywood Dump.

AGRICULTURAL INSECTICIDE USE

On 23 April, Dr. Gerald Lauer from the Region IV office, spoke to a cotton farmer named Mr. Ross. Dr. Lauer learned that there are several large cotton farms in the Nonconnah drainage area immediately outside the suburbs of Memphis in the vicinity of Ross and Holmes Roads. Mr. Ross could not provide information about acreages and specific usage practices. However, he did give a partial listing of insecticides used in the area. These were toxaphene, DDT, Malathion, and 2% Endrin.

Dr. Lauer also spoke to the operator of the Memphis Flying Service on Winchester Road.

This is in the upstream area of Nonconnah Creek. This is upstream from McKellar Lake, about 20 miles upstream from the confluence of Nonconnah Creek and McKellar Lake.

He learned that there has been no dusting or spraying operation out of this air strip for the last four or five years. It was determined that Mr. Alvin Poudart of West Memphis does most of the aerial dusting and spraying in the Winchester-Ross Road area. Mr. Wilson, operator of Wilson Field (Ridgeway and East Raines Road) said Mr. Poudart worked out of his air strip several times last year. This included loading the aircraft with insecticides.

RESULTS

The following tables show the results of insecticide determinations made on mud, sewage, solid waste, and soil samples. All quantitative data are the results of microcoulometric gas chromatography. Qualitative results, in some cases, were obtained by thin-layer chromatography. The gas chromatographic assembly consisted of the following components: a Micro Tek 2530 R chromatographic unit; a Dohrmann Instrument Company S-100 combustion unit; C-1 -- Coulometer, and a T-200 microcoulometric titration cell; and a Brown Y 153X recorder equipped with a disc-integrator. Infrared identifications were made on a Perkin-Elmer Infrared Spectrophotometer Model 521.

Table 1: This sample site is the Velsicol plant in Memphis, Tennessee.

A. R. Grzenda

The first site sample was the Parshall Flume coming out of the agitation tank. This liquid sample was a composite of 10 aliquots collected proportional to discharge from 0945-1545 hours. This sample was split with the Velsicol Chemical Corporation, and the common vessel that the sample was composited in was rinsed with chloroform obtained from the Velsicol Chemical Corporation. This solvent rinse was also split with Velsicol for analysis.

The composite sample contained 58 parts per billion of Endrin and 7 parts per billion of Dieldrin.

The chloroform -- and again, this is Velsicol chloroform -- was negative for both Endrin and Dieldrin.

Now, we made some calculated rates of Endrin and Dieldrin discharge from the discharge measurements obtained from the Parshall Flume. These were as follows:

On 24 April the samples -- these were ten discharge measurements and one composite sample collected during the hours indicated -- produced a calculated discharge rate carrying the dimension of pounds of Endrin or Dieldrin per day. The rate for Endrin was 1.5 pounds of Endrin per day and 0.18 pounds of Dieldrin.

Again, samples also collected from the Parshall Flume. One was collected 7 April. This was collected by Mr. Chaney of the Memphis-Shelby County Health Department, and this liquid sample contained 50 parts per billion of Endrin and 60 parts per billion of Dieldrin.

A grab sample collected by me on 24 April contained 65 parts per billion of Endrin and 10 parts per billion of Dieldrin. This sample was also split with Velsicol.

The next sampling site was the agitation tank leading to the Parshall Flume. This was a composite of sludge taken from the side and the middle of the agitation tank. Again, this sediment sample or sludge sample was split with Velsicol.

This sample contained, on a dry-weight basis, 1,900,000 parts per billion of Endrin and 94,000 parts per billion of Dieldrin.

Again, the quantitative data were the results of microcoulometric gas chromatography. However, infrafred spectroscopy indicated the qualitative presence of both Endrin and Dieldrin in this sludge taken from the Velsicol plant.

A fraction of this sample was also sent to Dr. Wilcox of the Department of Chemistry at Emory University, and he reported the presence of Dieldrin by nuclear magnetic resonance.

So, this sample has been verified by

microcoulometric gas chromatography and infrared spectroscopy for Endrin and for Dieldrin by the nuclear magnetic resonance technique.

The next sample collected was taken from the Velsicol plant. These are samples of the Dempster Dumpster which were to be trucked to the Hollywood Dump. Again, the samples were split with Velsicol.

The sample description, which is filter-cake, was obtained from Mr. Harry Scarborough, Assistant Production Superintendent of the Velsicol Plant. The filter-cake contained 120,000 parts of Dieldrin per billion, 128,000 parts per billion or 12.8 percent dry weight of heptachlor, and 46 million parts per billion of heptachlor epoxide, or 4.6 percent by dry weight.

Additional samples were collected from the PCL plant. Again, these were taken from drums which were to be trucked to the Hollywood Dump. Again, the sample was split with Velsicol.

These came from several drums and there were materials varying in color. I have described them as orange, rust-red and red-black.

All of these materials were negative for Endrin and Dieldrin. However, microcoulometric gas chromatography indicated a diversity of chlorinated hydrocarbons. In other words, we got peaks, but we could not relate them to any of the standards that we had for Endrin or Dieldrin. So they do contain unidentified chlorinated hydrocarbon compounds.

The next sampling site I will discuss is the sewers in the railroad yard adjacent to the Velsicol plant.

Samples were taken of liquid and sludge on 5 and 10 April. The range for four liquid samples collected during these dates was from 117 to 500 parts per billion of Endrin, and from 40 to 86 parts per billion of Dieldrin.

On the two sludge samples, these contained from zero to 1,996,000 parts per billion of Endrin, and from 483,000 to 77,000,000 parts per billion of Dieldrin.

MR. STEIN: Dr. Grzenda, were these in the sewers outside the Velsicol plant?

DR. GRZENDA: This is correct. These were taken out of the 36-inch trade waste sewer, which is immediately adjacent to the Velsicol plant, not more than, oh, five or six feet from the fence line.

MR. JONES: What quantity of sludge was that, Doctor?

DR. GRZENDA: Pardon me?

MR. JONES: What quantity of sludge?

DR. GRZENDA: Do you mean the sludge in the sewer or the sample site?

MR. JONES: I don't care about the sample site. I am talking about the sludge in the sewer.

DR. GRZENDA: I don't know what the total quantity was. I can only say that it was quite easy to drop an Eckman dredge into the 36-inch manhole and obtain a specimen of the sludge.

MR. STEIN: How big is an Eckman dredge? Could you see it?

DR. GRZENDA: No, sir.

MR. STEIN: I mean, you couldn't see the amount by the eye? Would you need a microscope to look at it?

DR. GRZENDA: No, sir. Again, this 36-inch trade waste sewer had an 8-inch line discharging into it.

Now, I could see the sludge on this shelf of material which I described. However, at this first visit, we did not notice the 8-inch line. Nothing was discharging through it at the time.

However, we did notice this crust of sludge, both hardened and partially hardened, around the circumference of the manhole, and what we did was lower the dredge in a hole through this crust into the 36-inch line, and it was easy to obtain a sampling.

MR. STEIN: How big is that dredge?

DR. GRZENDA: It measures probably 10 by 10 or

12 by 12 -- a quarter of a square foot -- yes, that's it.

MR. STEIN: A quarter of a square foot, and you dropped that in and got the sludge out?

DR. GRZENDA: That is correct.

The next sample taken refers to liquid and sludge samples collected from the 8-inch line which discharges into the 36-inch line, which was mentioned at sampling site A. This is the 36-inch trade waste sewer. These samples were all collected on 10 April.

The liquid samples contained from 108 to 333 parts per billion of Endrin, and from 69 to 215 parts per billion of Dieldrin.

The single sludge sample which was taken contained 351,000 parts per billion of Endrin, and 76,000 parts per billion of Dieldrin.

We also sampled the drop manhole. We later decided this received the effluent from the Parshall Flume.

This was a liquid sample collected on April 10, which contained 168 parts per billion of Endrin, and 11 parts per billion of Dieldrin.

The next was a manhole by the junk yard on the 36-inch trade waste sewer. Again, this sampling site was upstream, so to speak, on the sewer line, from all known points of Velsicol discharge, and this sample was collected on April 10th.

It was liquid, and it contained 20 parts per billion of Endrin and 4 parts per billion of Dieldrin.

Again, on 10 April we sampled the trade waste sewer in the vicinity of Peres Street. This sewer is in the vicinity of the pumping station and would contain all of the wastes, except the cooling water wastes and those hauled to the Hollywood Dump originating from Velsicol.

On 10 April a liquid sample contained 1,270 parts per billion of Endrin, and 97 parts per billion of Dieldrin.

A composite liquid sample collected from the 28th of April to the 29th of April -- that is, from 1800 hours on the 28th to 1930 hours on the 29th -- this is a composite of 24 aliquots taken proportional to flow.

Mr. Chairman, these data were not available when this report was written. I trust they will be included in the record?

MR. STEIN: Do you have the whole table there?

DR. GRZENDA: Pardon?

MR. STEIN: Have you read all the data you want in the record?

DR. GRZENDA: No, I have not I just wish to indicate --

MR. STEIN: You go ahead.

DR. GRZENDA: All right.

Again, the liquid composite contained 39 parts per billion of Endrin and 14 parts per billion of Dieldrin.

Based on 24 discharge measurements and 24 aliquots, the calculated rate of discharge from this sewer, in pounds per day, would be 7.1 of Endrin and 2.56 pounds per day of Dieldrin.

Now, this sewer is very close to the interceptor, so these figures would approximate or estimate the quantities of Endrin which were discharged into the Mississippi River on 28 and 29 April.

In other words, this sewer was in the vicinity of the interceptor which carried these wastes to the Mississippi River. Earlier in my presentation, I mentioned that a portion of this flow had been bypassed into this lake which drains into the Wolf River, so this estimate of 7.1 and 2.56 pounds of Endrin and Dieldrin respectively would be a quantity perhaps as high as a fourth, which was going into the Wolf River.

On an annual basis, these rates of 7.1 pounds of Endrin and 2.5 pounds per day of Dieldrin, the annual calculated rate, based on these figures, would be roughly about 2,000 pounds of Endrin per year.

A. R. Grzenda

I played with some figures that Dr. Mount gave me relative to blood volume and toxic concentration in blood of catfish, and just playing around with a pencil, I figured if only one one-thousandth of this amount of Endrin -- that is, if only two pounds of Endrin found its way into the blood of fish, it would have the potential of killing 45 million one-pound catfish.

Now, this is not the whole load, but merely one one-thousandth, or two pounds, out of the annual estimated load.

The next sampling site I will discuss is Cypress Creek.

Again, prior to June 1963, this site received all processed wastes except those hauled to the dump from Velsicol.

In June 1963, the trade waste sewer and the interceptor sewer was built, and, therefore, since June 1963, we believe that this site has been receiving only cooling water wastes.

Samples of mud and water were collected above the Velsicol cooling water outfall. This is perhaps an eighth to a quarter of a mile upstream from the outfall. These samples were collected on 5, 9 and 10 April. There were three water and two mud samples. All of these samples were negative for both Endrin and Dieldrin.

Seven liquid waste samples were collected right from the 24-inch outfall coming out of the Velsicol plant. These samples were collected on 5 April, 9 April and 10 April.

In the liquid samples, the Endrin concentration ranged from 1 to 150 parts per billion of Endrin, and from zero to 7.1 parts per billion of Dieldrin.

As I mentioned, Mr. Jelin from the Taft Center at Cincinnati made some discharge measurements on this cooling water outfall.

Again, these were on 9 April. The calculated rate of discharge in pounds per day of Endrin from the cooling water outfall would be 0.031 pounds per day of Endrin, and 0.004 pounds per day of Dieldrin. These calculated rates were based on six discharge measurements and four grab samples taken from 1240 to 1650 hours on 9 April.

This work was repeated on 10 April from 0830 to 1230 hours, nine discharge measurements and three grab samples. Again, the computed rates or calculated discharge rates expressed in pounds per day were 0.034 pounds per day of Endrin, and 0.016 pounds per day of Dieldrin.

The next sampling site I will discuss is still on Cypress Creek. It is the Meager Street Bridge, located one-half mile downstream from the Velsicol cooling water outfall.

Mud samples were collected on 5, 10 and 15 April, and water on 10 and 15 April.

The sludge or mud samples contained from 40,000 to 4,600,000 parts per billion of Endrin, and the liquid samples contained from 1.7 to 233 parts per billion of Endrin.

The mud samples contained from 40,000 parts per billion of Dieldrin to 1,050,000 parts per billion of Dieldrin.

The water samples contained from 0.5 to 50 parts per billion of Dieldrin.

These figures I gave you on the sludge samples are the sediments which were ultimately hauled to the Hollywood Dump.

Springdale Street Bridge: This is located 1.2 miles downstream from the Velsicol cooling water outfall, again still in Cypress Creek.

Mud and water samples were taken on 10 April. The water contained 6.9 parts per billion of Endrin and 2.4 parts per billion of Dieldrin.

The mud samples contained 116,000 parts per billion of Endrin and 76,000 parts per billion of Dieldrin.

The next is taken at North Watkins Street Bridge, 2.6 miles downstream from the Velsicol cooling water outfall. These samples were also taken on 10 April. The water contained 1 part per billion of Endrin and 1.5 parts per billion of Dieldrin.

The mud contained 29,200 parts per billion of Endrin and 5,200 parts per billion of Dieldrin.

Again, on the Cypress Creek pumping station: This pumping station pumps the water from Cypress Creek into another ditch, and in a short distance it winds up in the Wolf River. This pumping station is roughly 3.3 miles downstream from the Velsicol cooling water outfall.

The water contained 1.4 parts per billion of Endrin and 0.24 parts per billion of Dieldrin.

The mud contained 16,000 parts per billion of Endrin, and 7,400 parts per billion of Dieldrin.

The next site sampled was the Wolf River. If you recollect, this is the stream which more or less bounds the northern limit of the City of Memphis.

The first samples I will report on were collected from the Highway 40 Bridge. This is upstream from both the Hollywood Dump and Cypress Creek. Therefore, this station is upstream from all samples from all points where Velsicol is known to dispose or discharge waste.

The water contained neither Endrin nor Dieldrin.

However, the mud contained 60 parts per billion of Endrin and 15 parts per billion of Dieldrin.

Next is the Summer Avenue Bridge. Again, this is both upstream from the Hollywood Dump and Cypress Creek. It is about an eighth of a mile downstream from the Highway 40 Bridge.

Mud and water samples collected on the 10th of April were negative for both Endrin and Dieldrin.

Now we are at the Hollywood Dump. These particular samples were collected on the banks and the flood plain of the Wolf River, with the exception of the mud sample. This mud sample, this material that was hauled from Cypress Creek, was located on the slopes immediately adjacent to the flood plain.

Soil collected on 10 April -- again, this was a selected sample. I walked around the dump until I detected odors, and I took a sample of the soil in this area. The soil contained 27,000 parts per billion of Endrin, and 151,000 parts per billion of Dieldrin.

Water in a trench in the Hollywood Dump -- again, this trench is subject to flooding -- a surface water sample contained 9.4 parts per billion of Endrin and 1.7 parts per billion of Dieldrin.

A subsurface water sample contained roughly half the quantities of these chemicals.

With reference to the 9.4 figure, this water sample was taken by skimming over the surface to obtain the crystalline material which you saw in the slides. This sample did contain crystalline material.

On April 15th, these were samples which I obtained from the U. S. Department of Agriculture. They were composites of individual samples collected by them, by Dr. Barthel in the presence of Mr. Fairall of our organization.

On 15 April, solids were collected from a drum labeled "Isodrin Scraps." This contained 156,000,000 parts per billion Isodrin, or 15.6 parts per billion of Isodrin by dry weight.

On April 15th, again samples composited from samples taken by the U. S. Department of Agriculture, two samples that were negative for both Endrin and Dieldrin. However, the presence of other unidentified chlorinated hydrocarbons was indicated by microcoulometric gas chromatography, but the samples were both negative in Endrin and Dieldrin.

On 24 April, I took a composite of mud. This is the material that had been hauled from Cypress Creek earlier in the month, and this sample was split with Velsicol. This sample contained 1,180,000 parts per billion of Endrin, and 530,000 parts per billion of Dieldrin.

Then we took a sample of mud and water on 10 April on the North Hollywood Street Bridge by the Hollywood Dump, but upstream from Cypress Creek. The water contained no Endrin or Dieldrin. The mud contained 13 parts per billion of Endrin, and 2 parts per billion of Dieldrin.

The next is the North Watkins Street Bridge, which is downstream from the Hollywood Dump, but upstream from Cypress Creek. The water collected on 10 April contained neither Endrin nor Dieldrin. The mud contained 76 parts per billion of Endrin and 18 parts per billion of Dieldrin.

The Highway 51 Bridge is almost to the Mississippi River. Mud and water samples were collected on 10 April and 24 April, three samples.

The range of the mud samples varied from 160 to 7,500 parts per billion of Endrin, and in water from 0 to 1.1 parts per billion of Endrin. The same samples in mud for Dieldrin contained 100 to 5,000 parts per billion of Dieldrin, and in the water samples from 0 to 0.03 parts per billion of Dieldrin.

The next sampling site I will discuss is Nonconnah Creek in the vicinity of Memphis.

Nonconnah Creek, to refresh your mind, is the stream that more or less marks the southern boundary of the

City of Memphis. Again, this stream is not thought or believed to receive any waste directly from Velsicol.

On 23 April, a series of water samples was collected in the upstream areas of Nonconnah Creek in relation to McKellar Lake. Twenty-two miles upstream from the confluence with McKellar Lake, they were negative for Endrin and Dieldrin.

On a bridge on a tributary, also 22 miles upstream from the confluence, the water sample on the 23rd was also negative for Endrin and Dieldrin.

Again, samples taken from a bridge 20 miles upstream from the confluence, water was also negative for Endrin and Dieldrin on the 23rd.

At a bridge 17.9 miles upstream from the confluence, on 23 April, samples taken were also negative for Endrin and Dieldrin.

Now, at a bridge 16.4 miles upstream from the confluence, this water sample collected on 23 April contained 0.16 parts per billion of Endrin and 0.07 parts per billion of Dieldrin.

At a bridge located 14.7 miles upstream from the confluence, a water sample taken on 23 April was negative for both Endrin and Dieldrin.

At a bridge 11.6 miles upstream from the confluence, water was collected on 16 April and contained 0.19 parts per billion of Endrin, and was negative for Dieldrin.

Mud collected on the same day contained 9 parts per billion of Endrin, and 3.5 parts per billion of Dieldrin.

Water collected on the 23rd of April contained 0.03 parts per billion of Endrin and 0.03 parts per billion of Dieldrin.

At a bridge 8.3 miles upstream from the confluence of Nonconnah Creek with McKellar Lake, water and mud samples were collected on 10 April and 16 April. The muds on both sides were negative for Endrin and Dieldrin. The water samples contained 0.58 and 0.6 parts per billion of Endrin respectively, and all of the samples except one water sample collected on 16 April were negative to Dieldrin. The positive sample contained 0.2 parts per billion of Dieldrin.

Now, at the South Bellevue Dump, 4.0 miles upstream from the confluence of Nonconnah Creek with McKellar Lake -- this is a dump which had received drum wastes from the Jehl Cooperage Company -- on 23 April, water was collected from a ditch which drained the dump. This is not Nonconnah Creek water, but dump water. This sample contained 0.14 parts per billion of Endrin, and 0.04 parts per billion of Dieldrin. The sample also contained the 0.50 parts per billion of DDT.

A mud sample collected from the ditch -- this is mud underlying the water -- contained 6 parts per billion of Endrin and 2 parts per billion of Dieldrin, and 56 parts per billion of DDT.

Again, mud sampled from Nonconnah Creek immediately downstream from the Bellevue Dump, which is mud from Nonconnah Creek, contained 8 parts per billion of Endrin and 7 parts per billion of Dieldrin.

On 16 April we sampled another bridge 2.8 miles upstream from the confluence. The water contained 0.1 parts per billion of both Endrin and Dieldrin. The mud sample contained 8 parts per billion of Endrin and 3.3 parts per billion of Dieldrin.

At this site and all sites downstream -- in other words, from 2.8 miles upstream from the confluence to the confluence, on 16 April my sampler witnessed a fish kill. There was a fish kill going on in this portion of Nonconnah Creek when samples were collected. This is roughly over 2.8 miles upstream, and this was a small fish kill. The fish involved were carp, drum, and sunfish.

Again, on the 23rd of April we collected a water sample from a pumping station which pumps ditch water into Nonconnah Creek. The water contained no detectable amounts of Endrin and 0.3 parts per billion of Dieldrin.

Finally, at a station three-quarters of a mile upstream from the confluence with McKellar Lake, two water samples collected on 9 and 16 April contained from 0.26 to 1.1 parts per billion of Endrin, and mud contained from 0 to 30 parts per billion of Endrin. All samples, both mud and water, were negative for Dieldrin.

Again, we are downstream from Nonconnah Creek. We are in McKellar Lake, at the mouth of Nonconnah Creek, where it discharges into McKellar. Water and mud samples were collected on 16 and 24 April.

The water samples contained from 0 to 0.14 parts per billion of Endrin, and muds from 43 to 84 parts per billion of Endrin. The water samples were negative for Dieldrin, but the muds contained from 17 to 18 parts per billion of Dieldrin. The mud sample collected on 24 April also contained 230 parts per billion of DDT.

The second site sampled in McKellar Lake was at the mouth of Harbor Channel, and this would be where McKellar Lake forms Tennessee Chute.

The water sample collected 16 April contained 0.26 parts per billion of Endrin, and 0.1 parts per billion of Dieldrin. The mud contained 360 parts per billion of Endrin and 84 parts per billion of Dieldrin.

A. R. Grzenda

The next sampling site I will discuss is the Mississippi River in the vicinity of Memphis, Tennessee.

Again, to refresh your minds, the interceptor outfall is upstream from the confluence of the Wolf River and the Mississippi River. The Lousahatchie River is upstream from both the interceptor outfalls and Wolf River.

The first site was two miles above the Lousahatchie River. Two water and two mud samples were collected on 24 April. The muds and waters were negative for Endrin, but one of the mud samples contained two parts per billion of Dieldrin. The others were negative.

A quarter of a mile upstream from the Lousahatchie River, samples were collected on 16 April and 24 April. The Endrin concentration of the mud ranged from 0 to 15 parts per billion of Endrin, and the water ranged from 0.17 to 0.2 parts per billion of Endrin. The muds were negative for Dieldrin. However, the water contained from 0.07 to 0.1 parts per billion of Dieldrin.

The next site sampled on the Lousahatchie River a quarter mile downstream from the Lousahatchie River and upstream from the Wolf River and the interceptor outfall took place on 9 and 24 April. All samples, both mud and water, were negative for Endrin and Dieldrin.

On 16 April we sampled a site upstream from the

Wolf River, but downstream from the interceptor outfall, which carries Velsicol trade waste. The water sample contained 0.46 parts per billion of Endrin and 0.14 parts per billion of Dieldrin. The mud contained 15 parts per billion of Endrin, and no detectable quantities of Dieldrin.

The next sample site was a quarter of a mile downstream from the Wolf River, and it is also downstream from the interceptor outfall.

All additional subsequent sampling sites which I shall bring to your attention from this point on will have been downstream from both the Wolf River and the interceptor outfall.

On the 24th of April, the water contained 0.21 parts per billion of Endrin, and the mud 8 parts per billion of Endrin. The water contained 0.04 parts per billion of Dieldrin, and the mud 5 parts per billion of Dieldrin.

Still further downstream on the Mississippi River and a little above Hopefield Chute, on 16 April, the water contained 0.7 parts per billion of Endrin, and 0.4 parts per billion of Dieldrin. The mud contained 5.5 parts per billion of Endrin, and no detectable quantities of Dieldrin.

Again, downstream from the Wolf River and the interceptor outfall, on the east side of the river, neither the water nor the mud contained Endrin or Dieldrin on 24 April.

The next site sampled was the old Wolf River channel. The old Wolf River channel used to flow adjacent to the Memphis waterfront area. A levee was built there, so the Wolf River now discharges directly into the Mississippi in a westerly direction.

MR. STEIN: Off the record.

(Discussion off the record.)

MR. STEIN: Go ahead.

DR. GRZENDA: About prior to a year ago, the Wolf River flowed in a westerly direction and then flowed south along the Memphis waterfront area in a north-south direction. About a year ago a levee was built by the Corps of Engineers, so now the Wolf River discharges more directly into the Mississippi, but these are the samples of the old Wolf River channel.

North and near the levee, on April 24th, the water contained 0.06 parts per billion and 0.04 parts per billion of Dieldrin. The mud contained 70 parts per billion of Endrin and 40 parts per billion of Dieldrin.

On 16 and 24 April, water samples collected in the old Wolf River channel near the midpoint of the north-south access, water ranged from 0 to 0.14 parts per billion of Endrin, and no Dieldrin was found in the water. The mud samples ranged from 105 to 690 parts per billion of Endrin, and from 51 to 190 parts per billion of Dieldrin.

At the old Wolf River channel, south end, on 24 April, water was negative for both Endrin and Dieldrin, and mud contained 98 parts per billion of Endrin and 73 parts per billion of Dieldrin.

At the Mississippi River in the vicinity of the Memphis-Arkansas Bridge, samples were taken on 9, 16 and 24 April of mud and water. The water ranged from 0 to 0.32 parts per billion of Endrin, two were negative for Dieldrin and one contained 0.36 parts per billion of Dieldrin. The mud contained from 0 to 59 parts per billion of Endrin, and from 0 to 10 parts per billion of Dieldrin.

Now, still farther downstream, immediately below Tennessee Chute, mud and water samples were collected on 16 and 24 April. The water contained from 0.08 to 0.016 parts per billion of Endrin, and from 0 to 0.07 parts per billion of Dieldrin. The mud contained from 0 to 2 parts per billion of Endrin, and from 0 to 2 parts per billion of Dieldrin.

Finally, one-half mile downstream from the Tennessee Chute, on 24 April, the mud and water samples were negative for both Endrin and Dieldrin.

A. R. Grzenda

At long last the conclusions:

After four years of research on insecticide contamination of the aquatic environment, associated with agricultural insecticide uses in North Carolina, Alabama, and Louisiana, I have reached the following conclusions relative to the data presented.

1. The concentration of Endrin found in Velsicol sewage sludge was about 1/10 of the commercially formulated dust used to control the sugar cane borer -- an insect pest which attacks sugar cane.

2. The concentration of Dieldrin found in Velsicol sewage sludge exceeded that of the commercially formulated dust used to control the boll weevil -- an insect pest which attacks cotton.

3. The concentration of Endrin in the water and underlying mud in the ditches and natural surface waters in the vicinity of Memphis, Tennessee, exceeded, by far, all previously recorded data for a variety of chlorinated hydrocarbon insecticides, including Endrin and Dieldrin. Not all, but generally the worst, of this contamination was noted at sites known to be downstream from points used or previously used by the Velsicol Chemical Corporation for waste discharge or disposal.

4. The Memphis complex, particularly the

Velsicol plant, is a significant source of Endrin and Dieldrin contamination in the Mississippi River.

Thank you for your patience.

(Tables 1 through 8 and attached maps are as follows:)

Table 1

SAMPLE SITE: VELSICOL PLANT, MEMPHIS, TENNESSEE

DATE (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
A. Parshall Flume at Velsicol agitation tank. Composite of 10 aliquots collected proportional to discharge from 0945-1545 hours. Sample split with Velsicol.			
24 Apr	liquid	58	7
B. Same site as (A), but grab samples.			Sample (Collected on 24 Apr
7 Apr 3/	liquid	50	16
24 Apr	liquid	65	10
C. Agitation tank leading to Parshall Flume. Composite of sludge taken from side and middle of tank. Sample split with Velsicol.			
24 Apr	sludge	1,900,000	94,000 1/
D. Heptachlor plant, solids taken from Dempster Dumpster to be trucked to Hollywood Dump. Sample split with Velsicol.			
24 Apr	filter-cake 2/	0	120,000
		heptachlor 128,000,000 (ppb) or 12.8% dry weight	
		heptachlor epoxide 46,000,000 (ppb) or 4.6% dry weight	
E. PCL plant, solids taken from drums to be trucked to Hollywood dump. Sample split with Velsicol.			
24 Apr	still bottoms 2/		
	1. orange	0	0
	2. rust-red	0	0
	3. red-black	0	0

1/ Infrared spectroscopy indicated the qualitative presence of dieldrin.

2/ Sample described by Mr. Harry Scarborough, Assistant Production Superintendent, Velsicol Plant, Memphis, Tennessee.

3/ Sample collected by Mr. Jimmy Chaney, Memphis-Shelby County Health Department.

Table 2

SAMPLE SITE: SEWERS IN RAILROAD YARD ADJACENT TO VELSICOL PLANT

Date (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
A. 36-inch trade waste sewer.			
5 Apr	liquid	500	40
5 Apr	sludge	0	77,000,000
10 Apr	liquid	136	42
10 Apr	liquid	290	86
10 Apr	liquid	117	68
10 Apr	sludge	1,996,000	483,000
B. 8-inch trade waste sewer discharging into 36-inch trade waste sewer (A).			
10 Apr	liquid	108	76
10 Apr	liquid	333	215
10 Apr	liquid	153	69
10 Apr	sludge	351,000	76,000
C. Drop manhole on 48-inch line coming from Velsicol plant, enters city sewer.			
10 Apr	liquid	168	11
D. Manhole by junk yard on 36-inch trade waste sewer.			
10 Apr	liquid	20	4

Table 2-[illegible]

SAMPLE SITE: TRADE WASTE SEWER IN THE VICINITY OF PERES STREET

DATE (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
10 Apr	liquid	1,270	97

Table 3

SAMPLE SITE: CYPRESS CREEK, MEMPHIS, TENNESSEE

Date (1964)	Sample type	Parts for Billion	
		Endrin	Dieldrin
A. Upstream from Velsicol cooling-water outfall.			
5 Apr	mud	0	0
5 Apr	water	0	0
9 Apr	water	0	0
10 Apr	water	0	0
10 Apr	mud	0	0
B. Velsicol cooling-water wastes.			
5 Apr	liquid	150	0
9 Apr	liquid	13.9	3.0
9 Apr	liquid	19	2.2
9 Apr	liquid	13	1.6
10 Apr	liquid	1	0.4
10 Apr	liquid	14.8	7.1
10 Apr	liquid	6.2	3.7
C. Meager Street bridge; 0.5 mile downstream Velsicol cooling water outfall.			
5 Apr	mud	40,000 1/	50,000 1/
10 Apr	water	1.7	0.5
10 Apr	mud	94,000 1/	40,000 1/
15 Apr	water	233	50
15 Apr	mud	4,600,000 1/	1,050,000 1/
D. Springdale Street bridge; 1.2 miles downstream from Velsicol cooling water outfall.			
10 Apr	water	6.9	2.4
10 Apr	mud	116,000	76,000
E. North Watkins Street bridge; 2.6 miles downstream from Velsicol cooling water outfall.			
10 Apr	water	1.0	1.5
10 Apr	mud	29,200	5,200
F. Cypress Creek Pumping Station; 3.3 miles downstream from Velsicol cooling water outfall.			
10 Apr	water	1.4	0.24
10 Apr	mud	16,000	7,400

1/ Samples from the sediment which was eventually hauled to the Hollywood dump.

Table 4

SITE SAMPLED: WOLF RIVER, MEMPHIS, TENNESSEE

Date (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
A.	Highway 40 bridge upstream Hollywood dump and Cypress Creek.		
16 Apr	water	0	0
16 Apr	mud	60	15
B.	Summer Avenue bridge upstream from Hollywood dump and Cypress Creek.		
10 Apr	water	0	0
10 Apr	mud	0	0
C.	Hollywood Avenue dump on the banks and flood plain of the Wolf River.		
10 Apr	soil	27,000	151,000
15 Apr	water (in trench)	9.4	1.7
15 Apr	water (in trench)	4.4	0.6
15 Apr	solids from drum labeled "isodrin scraps" 2/	1/	1/
		Isodrin (ppb) 156,000,000 5/ or 15.6% Isodrin dry wt.	
15 Apr	solids from drum 3/	0	0
15 Apr	solids from drum 4/	0	0
15 Apr	mud (composite) hauled from Cypress Creek	2,650,000	780,000
24 Apr	mud (composite) hauled from Cypress Creek. Sample split with Velsicol.	1,180,000	530,000
D.	North Hollywood Street bridge by Hollywood dump upstream from Cypress Creek.		
10 Apr	water	0	0
10 Apr	mud	13	2
E.	North Watkins Street bridge downstream from Hollywood dump upstream from Cypress Creek.		
10 Apr	water	0	0
10 Apr	mud	76	18

Table 4 (cont'd)

SITE SAMPLED: WOLF RIVER, MEMPHIS, TENNESSEE

Date (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
F. Vicinity of highway 51 bridge downstream from Hollywood dump and Cypress Creek			
10 Apr	water	1.1	0
10 Apr	mud	256	210
16 Apr	water	0	0
16 Apr	mud	7,500	5,000
24 Apr	water	0.11	0.03
24 Apr	mud	160	100

1/ Analyses not completed for endrin and dieldrin.

2/ Composited from U.S. Department of Agriculture sample nos. 16, 17, & 18.

3/ Composited from U.S. Department of Agriculture sample nos. 7, 8, & 10.

4/ Taken from U.S. Department of Agriculture sample no. 19.

5/ Thin-layer chromatography also indicated the presence of Isodrin.

TABLE 5

SITE SAMPLED: NONCONNAH CREEK IN THE VICINITY OF MEMPHIS

Date (1964)	Sample Type	Parts Per Billion		
		Endrin		Dieldrin
A. Holmes Road; west bridge, 22 miles upstream from confluence with McKellar Lake.				
23 Apr	water	0		0
B. Holmes Road; east bridge, 22 miles upstream from confluence				
23 Apr	water	0		0
C. Forest Hills Road bridge, 20 miles upstream from confluence				
23 Apr	water	0		0
D. Hacks Cross Road bridge, 17.9 miles upstream from confluence				
23 Apr	water	0		0
E. Winchester Road bridge, 16.4 miles upstream from confluence				
23 Apr	water	0.16		0.07
F. Kirby Road bridge, 14.7 miles upstream from confluence				
23 Apr	water	0		0
G. Mt. Moriah Road bridge, 11.6 miles upstream from confluence				
16 Apr	water	0.19		0
16 Apr	mud	9		3.5
23 Apr	water	0.03		0.03
H. Lamar Street, bridge, 8.3 miles upstream from confluence				
10 Apr	water	0.58		0
10 Apr	mud	0		0
16 Apr	water	0.6		0.2
16 Apr	mud	0		0
I. South Bellevue dump, 4.0 miles upstream from confluence. Dump received insecticide drum wastes from Jehl Cooperage Company.				
23 Apr	water (from ditch draining dump)	0.14	0.50 (DDT)	0.04
23 Apr	mud (from ditch draining dump)	6	56 (DDT)	2

TABLE 5 (Cont'd.)

SITE SAMPLED: NONCONNAH CREEK IN THE VICINITY OF MEMPHIS (Cont'd.)

Date (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
J. Highway 51 bridge, by Bellevue dump			
14 Apr	mud	8	7
K. RR bridge upstream from pumping station, 2.8 miles upstream from confluence.			
16 Apr	water	*0.1	0.1
16 Apr	mud	*8	3.3
L. Effluent from pumping station, 2.0 miles upstream from confluence.			
23 Apr	water	0	0.3
M. RR bridge downstream from pumping station, 0.75 miles upstream from confluence.			
9 Apr	water	1.1	0
9 Apr	mud	0	0
16 Apr	water	*0.26	0
16 Apr	mud	*30	0

* Small numbers of dead or distressed fish (carp, drum, and sunfish) were observed from the mouth of Nonconnah Creek upstream to the pumping station.

Table 6

SITE SAMPLED: McKELLAR LAKE, MEMPHIS, TENNESSEE

Date (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
A. At the mouth of Nonconnah Creek			
16 Apr	water	0.14	0
16 Apr	mud	84	17
24 Apr	water	0	0
24 Apr	mud	43	18 230 (DDT)
B. At mouth of harbor channel			
16 Apr	water	0.26	0.1
16 Apr	mud	360	84

Table 7

SAMPLE SITE: MISSISSIPPI RIVER IN THE VICINTY OF MEMPHIS, TENN.

Date (1964)	Sample Type	Parts Per Billion	
		Endrin	Dieldrin
A. Two miles above the Lossahatchie River.			
24 Apr	water (mid-stream)	0	0
24 Apr	mud (mid-stream)	0	2
24 Apr	water (west bank)	0	0
24 Apr	mud (west bank)	0	0
B. 1/4-mile upstream from the Lossahatchie River.			
16 Apr	water	0.2	0.1
16 Apr	mud	15	0
24 Apr	water	0.17	0.07
24 Apr	mud (2 samples)	0	0
C. 1/4-mile downstream from the Lossahatchie River, upstream from Wolf River and interceptor outfall.			
9 Apr	water	0	0
9 Apr	mud	0	0
24 Apr	water	0	0
24 Apr	mud	0	0
D. Downstream from interceptor outfall, and upstream from Wolf River.			
16 Apr	water	0.46	0.14
16 Apr	mud	15	0
E. 1/4-mile downstream from Wolf River, and downstream from interceptor outfall.			
24 Apr	water	0.21	0.04
24 Apr	mud	8	5
F. Downstream from the Wolf River, above Hopefield Chute.			
16 Apr	water	0.7	0.4
16 Apr	mud	5.5	0
G. Downstream from the Wolf River, across from Hopefield Chute.			
24 Apr	water	0	0
24 Apr	mud	0	0

Table 7 (cont'd)

SAMPLE SITE: MISSISSIPPI RIVER IN THE VICINITY OF MEMPHIS, TENN.

Date (1964)	Sample Type	Parts Per Billion Endrin	 Dieldrin
H. Old Wolf River Channel, north end near levee.			
24 Apr	water	0.06	0.04
24 Apr	mud	70	40
I. Old Wolf River Channel, near mid-point of north-south axis.			
16 Apr	water	0.14	0
16 Apr	mud	690	190
24 Apr	water	0	0
24 Apr	mud	105	51
J. Old Wolf River Channel, south end.			
24 Apr	water	0	0
24 Apr	mud	98	73
K. Memphis-Arkansas bridge.			
9 Apr	water	0.3	0
9 Apr	mud	59	10
16 Apr	water	0.32	0.36
16 Apr	mud	0	0
24 Apr	water	0	0
24 Apr	mud	5	2
L. Immediately below Tennessee Chute.			
16 Apr	water	0.08	0
16 Apr	mud	0	0
24 Apr	water	0.16	0.07
24 Apr	mud	2	2
M. 1/2-mile downstream from Tennessee Chute.			
24 Apr	water	0	0
24 Apr	mud	0	0

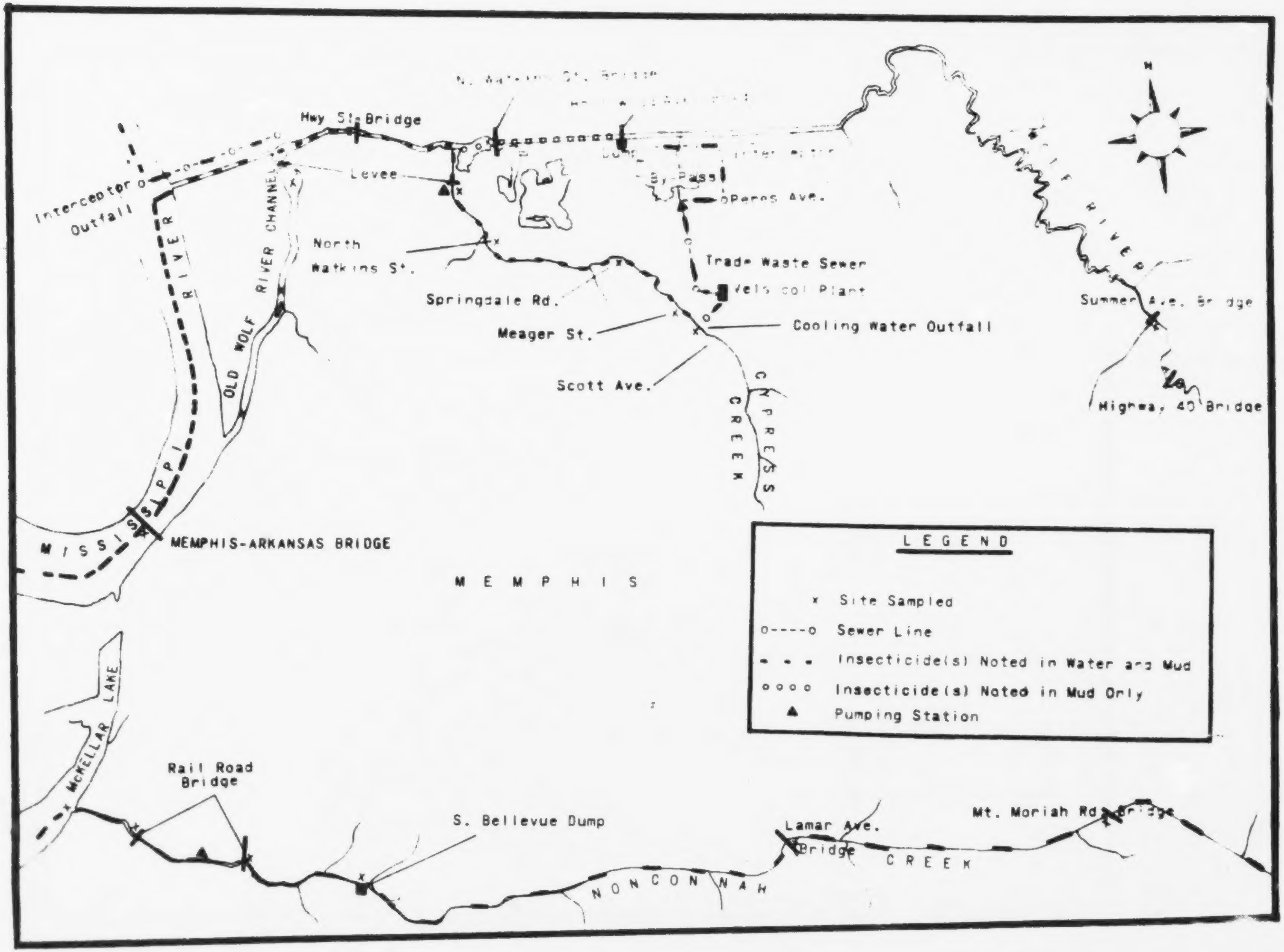
Table 8

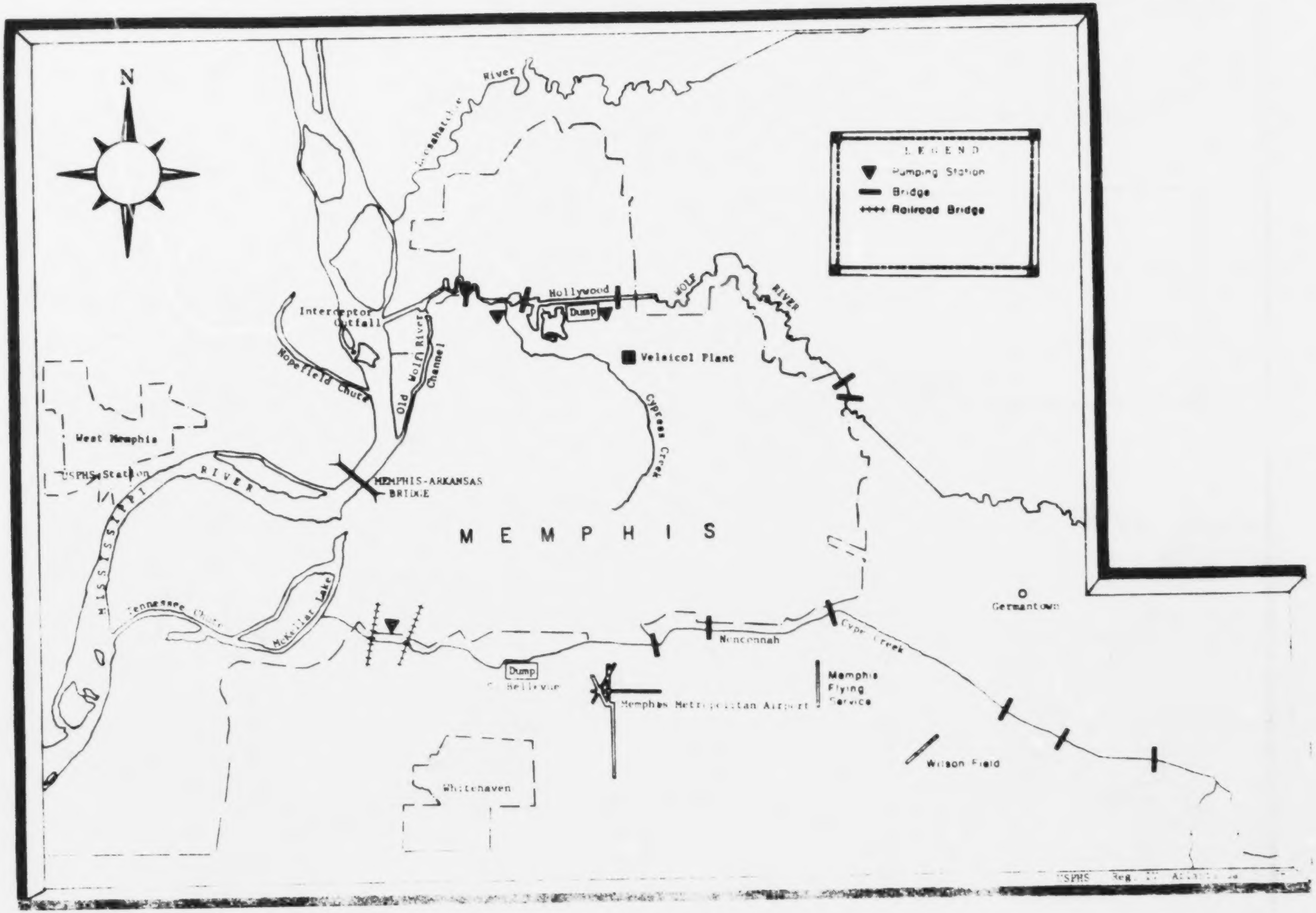
Some Calculated Rates of Endrin & Dieldrin Discharges 1/ in the Vicinity of the Velsicol Plant, Memphis, Tennessee

				Rate in lbs/day	
Date (1964)	Time of Flow Measurement (hours)	No. of Flow Readings	No. of Liquid Samples	Endrin	Dieldr
A. Parshall Flume, Velsicol plant					
24 Apr	0945 -1545	10	1 (composite)2/	1.50	0.18
B. Drop manhole on 48-inch sewer, known to receive a 24-inch sewer line from the Parshall Flume.					
10 Apr	1615	1	1	5.05	0.33
C. 24-inch cooling water outfall					
9 Apr	1240 -1650	6	4	0.031	0.004
10 Apr	0830 -1230	9	3	0.034	0.016
D. Manhole on 36-inch sewer line known to receive 8-inch sewer line from Velsicol.					
10 Apr	1500	1	1	0.32	0.19
E. Manhole on 36-inch sewer in junk yard adjacent to Velsicol plant.					
10 Apr	1630	1	1	0.14	0.03

1/ Rates are calculated for liquid fractions only and do not include rate of contribution from sludge and other deposits.

2/ Ten aliquots taken proportioned to flow, sample split with Velsicol.


N
N. Watkins St. Bridge
Hwy 51 Bridge
Interceptor Outfall
Levee
North Watkins St.
By-Pass
Peres Ave.
Trade Waste Sewer
Velsicol Plant
Cooling Water Outfall
Springdale Rd.
Meager St.
Scott Ave.
CYPRESS CREEK
WOLF RIVER
Summer Ave. Bridge
Highway 40 Bridge
OLD WOLF RIVER CHANNEL
MISSISSIPPI RIVER
MEMPHIS-ARKANSAS BRIDGE
MEMPHIS
McKELLAR LAKE
Rail Road Bridge
S. Bellevue Dump
NONCONNAH CREEK
Lamar Ave. Bridge
Mt. Moriah Rd. Bridge
LEGEND
x Site Sampled
o----o Sewer Line
▬ ▬ ▬ Insecticide(s) Noted in Water and Mud
o o o o Insecticide(s) Noted in Mud Only
▲ Pumping Station


N
LEGEND
▼ Pumping Station
Bridge
++++ Railroad Bridge
Loosahatchie River
Hollywood
Dump
WOLF RIVER
Interceptor Outfall
Hopefield Chute
Old Wolf River Channel
Velsicol Plant
Cypress Creek
West Memphis
USPHS Station
MISSISSIPPI RIVER
MEMPHIS-ARKANSAS BRIDGE
MEMPHIS
Tennessee Chute
McKellar Lake
Dump
Bellevue
Nonconnah
Cypre Creek
Germantown
Memphis Metropolitan Airport
Memphis Flying Service
Wilson Field
Whitehaven

USPHS Reg. [illegible]

MR. STEIN: Thank you, Dr. Grzenda, for a truly comprehensive report.

Do we have any comments or questions?

MR. ALBARES: I think Mr. Wood has some questions, but he stepped out.

MR. STEIN: You had a question before, Leary.

MR. JONES: Yes. I would like to see if we can get the count straightened out. I lost count somewhere.

MR. STEIN: All right.

MR. JONES: On the sewer going to the city sewer, Endrin, I think you had 7.1 pounds per day?

MR. GRZENDA: That is correct.

MR. JONES: And 2.56 pounds of Dieldrin?

DR. GRZENDA: That is correct.

MR. JONES: Now, I got lost. On Cypress Creek, this is the one I lost myself on.

DR. GRZENDA: All right. The cooling water outfall?

MR. JONES: Yes.

DR. GRZENDA: Again, this was not receiving process wastes, according to the best of our information.

On 9 April, it was 0.031 pounds per day of Endrin, and 0.004 pounds per day of Dieldrin.

MR. JONES: Yes.

DR. GRZENDA: At the same site, on 10 April it was 0.[illegible] pounds per day of Endrin, and 0.016 pounds per day of Dieldrin.

All right, sir?

MR. JONES: Right. Now, that would cover everything going into Cypress Creek from your map there, I believe -- those two sewers? I know this --

DR. GRZENDA: No, sir. Only the cooling water outfall discharges into Cypress Creek.

MR. JONES: All right. Then this 7.1 pounds goes to the city sewer?

DR. GRZENDA: That goes to the interceptor sewer, which discharges into the Mississippi.

MR. JONES: Did you calculate the pounds moving in the Wolf River for this part that was bypassed over through the lake? What I am after is the total pounds going into the Mississippi. There is no trick question there. In other words, are we talking about 8 pounds per day or [illegible] pounds per day? What is it?

DR. GRZENDA: All right. On the bypass --

MR. STEIN: No. The total pounds going to the Mississippi.

MR. JONES: In other words, you had some Wolf River samples down below everything from Hollywood Dump, and so forth. That dump is going to throw us off.

DR. GRZENDA: I do not have any discharge figures for the Wolf River, only for the sewer, and that is the 7.1 and the 2.56 pounds-per-day figure.

I think anything else that we might tack on from the bypass wouldn't affect the 7 pounds-per-day or the 2.5 pounds-per-day figure significantly.

MR. JONES: It would not?

MR. STEIN: What is the total estimate in pounds per day going into the Mississippi River from the Memphis complex? Is that it?

MR. JONES: I know this is not going to be an accurate figure, because they are grap samples.

MR. STEIN: Can you do it?

DR. GRZENDA: Yes, sir. If I add my cooling water wastes on to this 7.1 pounds per day, this is just going to affect third decimals.

MR. STEIN: You make your estimate. Go ahead, Doctor.

MR. JONES: Here is the problem on the 7 pounds. You say it was bypassed. That would be the same strength that was going to the sewer, wouldn't it?

MR. STEIN: While you are figuring, if we can go off the record for a minute here?

(Discussion off the record.)

MR. STEIN: Just give us an estimate.

DR. GRZENDA: All right. I will give you a precise figure in a moment.

I see in my presentation I skipped over one thing. All right, the total pounds of Endrin. Again, this is just for things that are in solution or suspended sediments. We had no way of estimating the sludge.

Taking into account our measurements from the trade waste sewer, which discharges into the interceptor, plus the quantity that came from the cooling water outfall, plus one measurement that we made on the bypass, it would amount to 7.18 pounds per day of Endrin, and 2.6 pounds per day of Dieldrin.

MR. STEIN: What was that Endrin figure again?

DR. GRZENDA: 7.18 pounds per day.

MR. STEIN: That is every day in the year?

DR. GRZENDA: Presumably so. I don't know.

MR. STEIN: You mean on an average?

DR. GRZENDA: No. I would not consider this an average figure.

MR. STEIN: Well, when do you think the 7.18 pounds per day go in? How many days a year?

DR. GRZENDA: I have no idea, sir. I would imagine that this is a --

MR. STEIN: A significant number a day?

DR. GRZENDA: Oh, yes. I regard this as a minimum estimate.

MR. STEIN: 7.2 pounds a day?

DR. GRZENDA: 7.2, rounded off.

MR. STEIN: 7.2, a minimum for what?

DR. GRZENDA: Of pounds per day.

MR. STEIN: For how many days?

DR. GRZENDA: For the entire year.

MR. STEIN: For the entire year?

MR. HOLEMAN: That is for the day tested.

MR. STEIN: Dr. Mount, if I recall your testimony before Senator Ribicoff in the Government Operations Committee, you said one drop of Endrin in the water around the Washington and Potomac River area would kill all the life. I presume 7.2 pounds is a little more than a drop?

DR. GRZENDA: Yes, sir.

DR. MOUNT: As to your last statement, that was based on other calculations, that it would be three drops per second into the Potomac River.

MR. STEIN: Three drops per second.

MR. JONES: How many pounds per day is that?

MR. STEIN: All right. Let's go back.

MR. JONES: I want to know how many pounds a day three drops per second is. This gives me a figure. This is strictly what was there one day. You have no basis as to whether it is a typical day or nontypical day because it was sampled one day.

DR. GRZENDA: Well --

MR. JONES: You project from one day. We do it all the time. I am not criticizing that. This is what I want to get.

DR. GRZENDA: But I don't accept this as a typical day.

MR. JONES: No. It is that day, an estimate of that day.

DR. GRZENDA: Of that day, but I think it was a nontypical day. After all, we had been sampling and people were aware of this.

I don't know. This is just opinion. Perhaps I shouldn't say this, but there is one thing I would like to point out.

MR. STEIN: Wait a moment. Let's get the answer.

Do you think this was a low day?

DR. GRZENDA: Well, let's look at the data, Mr. Stein.

MR. STEIN: Again?

DR. GRZENDA: On 10 April -- this was earlier in the month -- we took a liquid sample from this manhole in the area. Again, this was a grab sample. We found 1,270 parts per billion of Endrin, and 97 parts per billion of Dieldrin.

Now, on the basis of the days that we collected the composites to make the load estimate -- this was on the 28th and 29th of April -- we only noted 39 and 14 parts per billion of Endrin and Dieldrin respectively.

MR. JONES: Was that liquid, or was that sludge?

DR. GRZENDA: Again, that was liquid, sir.

MR. STEIN: You mean after you began to sample or it was known, you sampled and the loading of Endrin went down?

DR. GRZENDA: I would say so.

I think there are other examples of this in the data, if you look through them carefully.

MR. STEIN: In other words, you would say your 7.2 then is a minimum figure and you think a low figure? Let's have your opinion on that.

DR. GRZENDA: This is my opinion, that it is a low figure. Yes.

MR. STEIN: All right. Thank you. Go ahead.

MR. TRYGG: Is this 100 percent Endrin or is it 2 percent Endrin?

DR. GRZENDA: If I am correct, I believe this is based on technical Endrin, which is defined as being at least 85 percent Endrin. Correct?

MR. TEASLEY: In other words, it is calculated against theoretical Endrin.

DR. GRZENDA: All right. Mr. Teasley says it is calculated against theoretical Endrin, so it is 100 percent Endrin.

MR. TRYGG: It is 50 times that much of the Endrin that we are using on the crops. Is that right? I mean, this is one-fiftieth?

DR. GRZENDA: Yes. That's right.

MR. STEIN: Do you need anyone else up here to help you with this, Doctor?

DR. GRZENDA: No, sir. Two percent is generally what is used on crops. Yes.

MR. STEIN: Is this 50 percent more?

MR. TRYGG: One-fiftieth.

MR. STEIN: One-fiftieth. Your calculations are theoretically on 100 percent Endrin?

DR. GRZENDA: That is correct.

MR. STEIN: Does that answer it?

MR. LAFLEUR: One hundred percent or 85?

DR. GRZENDA: One hundred percent, sir.

MR. STEIN: All right.

MR. WOOD: Mr. Chairman, I would like to inquire if there were any biological samples taken in any of these areas, the tributary streams, Mississippi or Wolf River, and, if so, what were they and what analyses were run on the biological samples?

DR. GRZENDA: There were no biological samples taken by me or my samplers.

However, I am a biologist. I looked over the sediments collected from the Wolf River and Cypress Creek, and I did not note invertebrates in the mud.

Again, this was not a microscopic examination, but none were noted.

MR. WOOD: You mentioned earlier that some I.R. spectra and nuclear magnetic resonance were run on certain of these samples.

DR. GRZENDA: Yes, sir.

MR. WOOD: What is the relationship of the nuclear magnetic resonance with respect to it being an identification of chlorinated hydrocarbons, or a specific chlorinated hydrocarbon?

DR. GRZENDA: This is a relatively new technique.

I am really not competent to speak on it.

This sample was run by Dr. Wilcox from the Department of Chemistry at Emory University.

MR. WOOD: He is going to be here?

DR. GRZENDA: Any comment I would make on the technique would not really be cogent.

MR. WOOD: What about the I.R.?

DR. GRZENDA: The I.R.?

MR. WOOD: Who ran the I.R. spectrum?

DR. GRZENDA: The I.R. were run by chemists in our Atlanta laboratory.

MR. WOOD: Is there a specific absorption band for these two compounds, either one or both of them, that would function as a positive identification here?

DR. GRZENDA: Yes, sir. Our chemists referred to it as the type of identification that one could give us with a fingerprint, and they were working with the fingerprint zone on the absorption bands.

MR. STEIN: Is your chemist here now?

DR. GRZENDA: Yes, sir.

MR. STEIN: Maybe he can stand up. Would you introduce yourself?

MR. TEASLEY: Would you like to see the spectra?

MR. STEIN: Would you introduce your chemist, please?

DR. GRZENDA: All right. I would like to introduce -- excuse us while he gets the data.

MR. STEIN: He can answer the question.

MR. WOOD: Yes.

DR. GRZENDA: All right.

I would like to introduce one of our senior chemists, Mr. John Teasley.

MR. STEIN: You know, as a chemist I think any solvent has a saturation point that it can take. That includes people with data (laughter).

Do you want to go ahead, Mr. Wood?

MR. WOOD: I would just like to look at the spectra, if he has them, and go ahead.

MR. STEIN: All right.

Mr. Lafleur?

MR. LAFLEUR: Dr. Grzenda, I wonder if you would care to speculate, and I have reference here to Table 4 in your report, Page 74, there at the Highway 40 Bridge, and I think it is the North Hollywood Street Bridge by the Hollywood Dump, and again at the North Watkins Street Bridge, how it is that we would find those 60 parts per billion of Endrin in the mud and we would find none in the water. The same thing would be true for Dieldrin. You find this in at least three stations on that same page.

Would you care to comment on that?

DR. GRZENDA: Yes. Certain soil, the sand, glass, polyethylene, all of these things do absorb chlorinated hydrocarbon insecticides. In fact, even the metal cans which we sample from will absorb chlorinated hydrocarbon insecticides.

We do make it a practice to rinse out our sampling vessels, whether they be glass or metal, and include this in our samples.

MR. LAFLEUR: Would you not think as this water flowed over this mud there would be some leaking out of it from time to time?

DR. GRZENDA: I don't know. I imagine there might be some leaking from time to time. I do not have data to support this conclusion.

MR. STEIN: Are there any further questions?

(No response.)

MR. STEIN: Dr. Grzenda, you are an aquatic biologist. Is that right?

DR. GRZENDA: Yes, sir.

MR. STEIN: Did you notice a proliferation of aquatic life in Wolf Creek or a normal biota there?

DR. GRZENDA: No, sir. My observations of

Wolf River were quite cursory, and they were more or less just a rough examination of the sediments and sands which were collected in my Patterson dredge. They were generally devoid of micro invertebrates.

However, as far as Cypress Creek is concerned, I would best describe this as a biological desert. There was nothing in there. I looked at these sediments quite carefully, and there were many of them collected.

MR. STEIN: In other words, as we have found in other pollution cases, and I realize you are doing these analytical samples, but I assume you couldn't have helped but notice this as a trained biologist--you found in the waters below here what you would expect to find if a toxic substance were put in the water, as relates to the aquatic biota?

DR. ORZENDA: With reference to Cypress Creek, yes. There was just an absence, a complete absence, and this is typical, as you say, of toxic wastes.

MR. STEIN: Are there any further questions?

Mr. Jones, didn't you have a question you were asking Dr. Breidenbach? Did you want something on some figures that were given to you where we said the next speaker would have the information?

MR. JONES: This was what I have been looking for.

MR. STEIN: All right. You are satisfied?

MR. JONES: That calculation we are looking at, and we think our decimal right, .113 parts per trillion in the Mississippi average flow. I will not state that under oath because I don't know whether our decimal is right.

DR. ORZENDA: Give me that figure again, please?

MR. JONES: .113 parts per trillion.

MR. STEIN: That shows you the advantage of the conference technique, where we don't have these things under oath.

MR. JONES: I would think we did it honestly, though. Let's change that to .03.

DR. ORZENDA: .03?

MR. JONES: Give or take a few figures.

DR. ORZENDA: All right.

MR. WOOD: I had another one.

You earlier ventured an opinion as to possibly some of the operations going on within the plant. Would you care to expand that a little further?

I was curious as to whether or not this particular situation represents a normal agricultural practice with respect to manufacture or usage of agricultural chemicals.

DR. ORZENDA: I don't understand your question.

Would you rephrase it, please?

MR. WOOD: I simply asked if in your opinion this situation, which you have investigated, represents normal practice with respect to the manufacture or usage of packaging of agricultural chemicals.

DR. GRZENDA: I have no way of knowing this. The only Endrin plant I visited was the Velsicol installation at Memphis.

MR. STEIN: As far as I know, there is only one other plant that manufactures it, and you will have to go a long way to find that.

MR. WOOD: There are quite a few that make the chemicals.

MR. STEIN: That formulate it?

MR. WOOD: I was referring to the general formulation.

MR. STEIN: Have you checked on the general formulation, or has anyone, or are we going to have that on the general formula?

DR. GRZENDA: Mr. Fairall investigated this with the U. S. Department of Agriculture. I don't have his report with me.

MR. STEIN: Is Mr. Fairall here?

Would you come up, John? Let's see if we can answer this question. This, I think, is a fairly significant one if we can get the answer.

Did you hear the question?

MR. FAIRALL: Not in its entirety.

MR. STEIN: This deals with the practice in pesticide plants or agricultural chemical plants, the kind of housekeeping and discharge operations they do.

Would you say that the Velsicol plant was rather typical or not?

Dr. Grzenda, don't go off, because I have another question.

MR. FAIRALL: I will have to speak about manufacturing operations in general, because I have not visited other pesticide plants.

But, on the day of our visit, I think Velsicol's operations were, I would say, satisfactory. However, I will have to qualify this a bit by calling to your attention that since our write-up, they have changed their operations in 1963, and they certainly must be vastly improved now over what we see lying around in the sewers and in Cypress Creek.

MR. JONES: I have one question I would like to get clarified.

This is in a press report that did no one any good. Quoting here from the paper of April 23rd, which I think hit --

MR. STEIN: Which paper is this?

MR. JONES: This was in Nashville, Tennessee, but I think it hit most of the papers of the 23rd. It was written by Walter Sullivan, New York Times News Service -- they call it "By-Line, Washington," or, "Address, Washington," anyway.

> "Public Health officials said the corporation had refused them entrance to its premises."

Was that true?

MR. STEIN: Let me answer that question. I checked into that when I read it.

As far as I am concerned, and I think this is a legal concept more than anything else, we were not denied admission to the plant, and we were granted admission on the terms that Dr. Grzenda pointed out.

MR. JONES: How do you mean? What terms? Did you point that out on the sampling points?

DR. GRZENDA: No, sir. The best way to describe it, when we entered the plant, we were treated the same way you would treat a house guest. We were treated well, but the Velsicol Company more or less selected the sites which we sampled.

In other words, we told them the type of samples we wanted. We sampled the Parshall Flume, the agitation basin, the PCL plant, and the heptachlor plant.

We were told there were no solid wastes associated with Endrin manufacture and, therefore, there was no point to us going into the plant, nor were we permitted to wander around the plant looking for manholes, and this type of thing.

In other words, it was a guided tour through the plant.

MR. JONES: The reason I wanted to ask this was: You go into any industry from an insurance standpoint and you will get a guided tour.

DR. GRZENDA: Yes, sir.

MR. JONES: We have found the company extremely cooperative.

We can name dozens of plants within the State, and I have gone into almost every one of them, but there are certain processes they will have to clear with their home offices.

That is understandable, for the simple reason that the local man just does not have the authority to release certain processes, either under our law or under your law. However, I wanted to get clarified for the record the insinuation here where the Public Health official said that the corporation refused.

MR. STEIN: As far as we are concerned, we, the Department representatives, were admitted to the plant in accordance with standard American business practice, and we were not refused admission to the plant and do not so state.

Now, I read that for the first time in the Times myself.

MR. JONES: Yes. That clarifies it.

MR. STEIN: If anyone else has anything to say about it, let him say it.

I would not say that we weren't given the complete normal cooperation from the Velsicol Corporation that we get from any other industrial corporation, and, as a matter of fact, the kind of cooperation we expect from any American industrial corporation, and the kind of cooperation I think that we reciprocate to them and they can expect from us.

I don't think we have any complaint.

MR. JONES: I just wanted to clarify that.

MR. STEIN: Let me raise one point for clarification. Perhaps you will do this just so there will not be any criticism, and there is not meant to be.

Generally speaking, when an industry discharges its wastes directly into a stream, the industry is responsible. When they go through a municipal sewer, the city is responsible.

Just how do these wastes go? I don't know the answer and I don't want to guess at it, but, as I listened to your statement, part goes directly into the stream and part goes through the municipal sewers. Is that correct?

DR. GRZENDA: That is correct.

MR. STEIN: Is this in agreement?

MR. JONES: Yes.

MR. STEIN: All right. I just wanted to clarify that for the record, because this may be important later on when we decide what we are going to recommend.

Are there any other questions?

(No response.)

MR. STEIN: Thank you.

MR. SVORE: Thank you, Dr. Grzenda.

I would like to go on, Mr. Chairman, and introduce Mr. Frank W. Kittrell, who is Chief, Pollution Evaluation Section of the Technical Services Branch at the Taft Center, Cincinnati, Ohio.

He will discuss Lower Mississippi hydrology, municipal water supplies, sewage and industrial wastes, and

Endrin.

Mr. Kittrell.

STATEMENT OF FRANK W. KITTRELL, CHIEF, POLLUTION EVALUATION SECTION, TECHNICAL SERVICES BRANCH, UNITED STATES PUBLIC HEALTH SERVICE, ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO

MR. KITTRELL: Thank you.

LOWER MISSISSIPPI RIVER HYDROLOGY, MUNICIPAL WATER SUPPLIES, SEWAGE AND INDUSTRIAL WASTES AND ENDRIN

The Mississippi River funnels water from one-third of the United States to and through the State of Louisiana. Water that falls on areas as widely separated as western New York and western Montana, 1,800 miles apart, ultimately mingles to pass through the Delta to the Gulf of Mexico. Portions of the flow travel nearly 4,000 miles.

Much of the drainage area is blessed with an abundance of rainfall. Even when the flow is lowest, the river at Vicksburg, Mississippi, delivers 100,000 cubic feet per second (cfs) of water per day, which would supply the municipal needs of New Orleans for two years. At maximum flood the flow has been 20 times as great, or 2,000,000 cfs. Between these extremes more normal flows commonly range from 300,000 to 1,000,000 cfs. By any criterion the Mississippi is a tremendous stream, one of the world's largest.

This report deals with normal stream flows in the Mississippi River, municipal water supplies taken from, and sources of wastes discharging directly to, the Mississippi between the northern boundaries of Arkansas and Tennessee and the mouth of the river, and recapitulation of data on endrin in the Mississippi. While the focal point of the conference is pesticides and their effects on fish and potentially on humans, other aspects of pollution and its effects on water uses must not be ignored.

STREAM FLOWS

Flow records of the Mississippi River at a number of gaging stations between Memphis and New Orleans have been reviewed. The locations of gaging stations are shown in Figure 2.

There is an increase in flow of 21.2 percent between Memphis and Vicksburg. Between Vicksburg and the

Old River diversion there is only a limited increase in discharge. At Old River portions of the Mississippi River waters are diverted to join the Red River and travel down the Atchafalaya River to the Gulf of Mexico. At Donaldsonville, Louisiana, a small diversion occurs where water is pumped into Bayou La Fourche. As a result, the flow of the Mississippi below Donaldsonville to the mouth of the river is very nearly the same as that at Memphis.

The mean annual flow of the Mississippi at Memphis is 472,000 cfs, at Vicksburg 572,000 cfs, and at Red River Landing, just below the confluence of Old River, is 464,000 cfs.

Mean monthly flows of record for the Mississippi River at Memphis, Vicksburg, and Red River Landing, just below Old River, are given in Table 1 (Appendix) and are shown on Figure 1. The pattern of monthly flows at all three gaging stations is quite similar. Using the Vicksburg station as an example, the month of highest flow normally is April, with a mean discharge of nearly 1,000,000 cfs. From April to September the monthly flow drops steadily to 276,000 cfs. Flows in September and October are essentially the same, and are followed by a steady rise to the maximum in April. Mean monthly flows for the cold weather months range from 236,000 cfs in November to 618,000 cfs in February.

F. W. Kittrell

MUNICIPAL WATER SUPPLIES

One million one hundred and thirty-five thousand persons are served by 34 public systems which draw water from the Mississippi and Atchafalaya Rivers and Bayou La Fourche. The supplies are listed in Table 2 (Appendix) and the locations of the intakes are shown on Figure 3.

The land lying along the Mississippi in Arkansas, Mississippi and Tennessee is blessed with a bountiful supply of high quality underground water. The Memphis municipal water system, for example, is the largest in the world that depends entirely on ground water as the source of supply. Because of the abundance of good ground water most of the municipalities along the banks of the Mississippi River in the three upstream States draw their water supplies from underground sources.

In the three upstream States, Vicksburg along uses the river as the source of water supply. This supply serves a population of 41,000.

The major use of the Mississippi as a source of municipal water supply is in Louisiana. Here 33 systems serve more than 100 jurisdictions that range in population from 60 in English Turn, which is served by the Dalcour System, to 640,000 in New Orleans. The combined Louisiana population served with Mississippi River water is 1,094,000.

In addition to the municipal systems, six Louisiana industrial plants take water from the Mississippi River and provide potable water to their employees. Information on the number of persons served by these systems is not immediately available.

The river at the intakes of some of these supplies is subjected to excessive bacterial pollution by upstream sewage discharges. For example, while the complete treatment of Baton Rouge sewage contributes substantially to the protection of the New Orleans water supply, the New Orleans raw sewage imposes a heavy bacterial burden on source of supplies drawn from the river below New Orleans. Mechanical or human failure in water treatment of most surface water supplies could cause water-borne diseases among the water consumers. This hazard is magnified below New Orleans by the high bacterial content of the river water.

Industrial waste spills or other industrial accidents could cause interference with water treatment processes or tastes and odors in water supplies. This potential is attested by the Waterworks Warning Network in Louisiana, where industries, water supply systemsand the State cooperate in alerting waterworks officials of potential problems in treatment when industrial waste spills occur in the Mississippi.

F. W. Kittrell

A more subtle threat to water consumers is the unknown multitude of organic compounds from the numerous petrochemical and synthetic organic chemical processes which are wasted to the river. Although Endrin is highlighted at the moment, at least some of the other organic wastes justify consideration and investigation. The fact that Endrin has been detected in the treated water of a few of the municipal supplies indicates that others of the more obscure organic compounds very likely are present in the treated water also.

The presence of both Endrin and Dieldrin has been revealed in the treated water of the Vicksburg and New Orleans supplies through the results of a limited number of analyses performed by the Water Pollution Surveillance System of the Public Health Service. The results follow:

I have several columns here. First I will read the name of the town from which the treated water samples were collected, the dates of sample collection, the type of sample, and the quantities of Endrin and Dieldrin found.

MUNICIPALITY	DATE	TYPE OF SAMPLE	PARTS PER BILLION Endrin	 Dieldrin
CAPE GIRARDEAU, MO.	3/28-4/11-62	Carbon Filter	Neg.	0.001
VICKSBURG, MISS.	8/13-8/28-62	Carbon Filter	0.021	0.006
E. JEFFERSON PARISH, LA.	3/25/64	Grab	Neg.	Neg.
NEW ORLEANS, LA.	8/10-8/24-61	Carbon Filter	0.006	0.003
	7/10-7/25-63	Carbon Filter	0.014	0.010
	7/29-8/13-63	Carbon Filter	0.160	Neg.
	8/28-9/12-63	Carbon Filter	0.077	0.010
	3/5/64	Grab	0.025	<0.007
	4/7/64	Grab	Neg.	Neg.
	4/7/64	Grab	Neg.	Neg.

The presence of Endrin and Dieldrin in the Vicksburg and New Orleans water supplies definitely is a cause for concern. It is practically certain that no one has suffered acutely from this condition thus far. On the other hand, the sub-clinical effects of short-term ingestion, and the accumulative effects of long-continued ingestion of these toxic pesticides have not been defined. Either these compounds must be eliminated from the water supplies by control at the sources or by water treatment, or positive assurance must be forthcoming from some authoritative source that continued ingestion of a certain tolerance level in the supplies will not result in ultimate damage to health and well being of the 1,000,000 Mississippi and Louisiana water consumers.

SOURCES OF WASTES

The sources of wastes included in this report are limited to those situated on the banks of the Mississippi River that discharge either directly to the river, or to small local streams or ditches within a few miles of the river. Wastes that are discharged to tributary streams some distance from the Mississippi and may have measurable effects on quality of Mississippi River water are not covered in the present report.

SEWAGE

Six municipalities in Arkansas, two in Tennessee, three in Mississippi, and 17 in Louisiana, discharge sewage directly to the Mississippi River. Data on the individual discharges are presented in Table 3 (Appendix), and points of discharge are shown in Figure 4. On this chart, the black arrows represent untreated sewage, or all sewage discharges. The lighter colored arrows indicate treated sewage.

MR. STEIN: Mr. Kittrell, all the arrows will be dark in the report. You had better make a dash or put an open space in to distinguish between them.

MR. KITTRELL: The arrows that do represent the treated sewage will be either closed or they will be open arrows. I don't know which. Table 4 summarizes the data for the four States.

The combined sewered population of the 28 municipalities from which sewage is discharged directly to the Mississippi in the four States is 1,716,000. Fifteen of the 28 municipalities, with a combined sewered population of 1,483,000, or 86.4 percent of the total, do not provide sewage treatment. Municipalities in Arkansas account for less than one percent of the raw sewage, in Mississippi less than six percent, in Tennessee nearly 34 percent, and in Louisiana nearly 60 percent.

The largest city, New Orleans, Louisiana, does not provide sewage treatment. The 840,000 sewered population constitutes 56.6 percent of the total that discharges raw sewage. This sewered population has the dubious distinction of being the third largest in the country which has not provided sewage treatment. It is exceeded only by populations in the Boston metropolitan area, and on Manhattan Island, New York. Treatment plants are now under construction in all three areas.

The Memphis sewered population constitutes 32.1 percent of the total discharging untreated sewage. Memphis and New Orleans together account for 88.7 percent of the total.

Municipalities with sewage treatment range in sewered population from Elaine, Arkansas, with 650, to Baton Rouge, Louisiana, and its subdivisions, with 196,000.

The enormous numbers of bacteria in raw sewage include pathogenic bacteria that can cause water-borne diseases when ingested during contact with the water which receives the sewage. River reaches of greatest hazard to health from this cause probably are below Memphis and New Orleans.

SOURCES OF INDUSTRIAL WASTES

There are two heavily industrialized areas on the Lower Mississippi River. In Tennessee a variety of industries is centered in the Memphis metropolitan area. In Louisiana numerous industries are spaced along about 200 miles of the river between St. Francisville and Oakville, which is about 25 miles below New Orleans.

Table 5 (Appendix) lists industries situated along the Mississippi in the four States which potentially are sources of wastes that may affect water quality. The approximate locations of these industries are shown in Figure 5.

In addition to these plants there are many others, not listed, which discharge to municipal sewerage systems. The proper disposal of industrial wastes discharged to municipal systems is considered to be the responsibility of the municipalities.

No plants discharging wastes to the Mississippi River in Arkansas are reported.

In the Memphis metropolitan area 19 plants discharge industrial wastes to the Mississippi River or to Lousahatchie River, Wolf River, Cypress Creek or Nonconnah Creek, tributaries of the Mississippi River. Among them the plants process chemicals, metals, fertilizer, wood products, paper, vegetable oils, tires, textiles, petroleum and pesticides.

Six plants discharge to the river in Mississippi. They process chemicals, pulp and paper, building board, and lighting fixtures.

The 37 plants discharging to the Mississippi in Louisiana represent both the older manufacturing processes and the newer chemical technology. Among the older processes are cane sugar production, vegetable canning, pulp and paper manufacture, petroleum refining, vegetable oil refining, chemical processing, meat packing, cement production, wall-board manufacture, and aluminum smelting. The newer technology is represented by 13 petrochemical plants and a few synthetic chemical plants.

Aside from the pesticide problem, which has been covered in detail elsewhere, the potential for interference with water uses by industrial wastes includes taste and odor in water supplies, interference with water treatment processes, taste and odor in fish, damage to fish and other aquatic life, and aesthetic offense because of floating or suspended solids.

The river below Memphis and in the St. Francisville to Oakville, Louisiana, reach, where numerous water supply intakes are interspaced with many points of industrial waste discharge, are the stream sections where the potential for damage to water uses is most apt to materialize.

The degree to which any of these effects on water quality and uses may occur or may be anticipated can be assessed only by accumulation and evaluation of all existing data and information, probably supplemented by further detailed sampling and analysis of wastes and the river water.

In view of the physical characteristics of the Mississippi River and the large volume of flow, it appears that with the possible exception of bacterial examination, new methods of measurement will be necessary to detect adverse effects of pollution. In this case the petrochemical and other synthetic organic wastes will bear especially close scrutiny, possibly by methods yet to be evolved.

RECAPITULATION OF ENDRIN DATA

Several factors in addition to concentrations of a given constituent must be considered in abstracting the maximum information from a set of stream data.

One useful device is the conversion of concentrations into total pounds per day of the constituent carried past selected points on the stream each day. This requires a knowledge of stream flows during the times that samples are collected. The following table includes average stream flows during the period when carbon filter samples were collected at several points on the Mississippi River and the pounds per day of Endrin carried past those points on the river. The stream flows are preliminary estimates based on data supplied by the Mississippi River Commission at Vicksburg with the exception of that at Cape Girardeau. When official records become available they may vary somewhat from these values, but not sufficiently to change the conclusions drawn from this data. It must be reiterated that the Endrin values obtained by the carbon filter data represent something less than the total quantities of Endrin carried by the river, since the carbon does not absorb all Endrin in the water that passes through it. It is possible that the total pounds per day of Endrin carried by the river may be as much as 10 times the quantities given. For this reason, the pound per day values are designated as minimums in the table. Since the carbon filters generally are operated in a comparable manner at all sampling points, the relationship among the values at the several stations serve as a basis for certain conclusions.

Mr. Chairman, I will not read the table in full at this point, but I would like to have it incorporated in the record.

MR. STEIN: The table, without objection, will be incorporated in the record as if read.

(The table referred to is as follows:)

Dates	Stream Flow-Cubic Feet per Second	Endrin	
		Concentration Parts per Billion	Minimum Pounds per Day
Cape Girardeau, Mo. 1963	100,000*	0.001	0.5
West Memphis, Ark.			
8/13-8/20-1963	195,000	0.019	20.0
9/3- 9/9 -1963	167,000	0.026	23.0
9/30-10/14-1963	125,000	0.214	140.0
Vicksburg, Miss.			
8/5-8/15-1963	264,000	0.020	29.0
9/9-9/18-1963	191,000	0.020	20.0
10/9-10/18-1963	150,000	0.001	0.8
2/10-2/19-1964	286,000	0.039	60.0
Delta, La. 7/1-7/8-1963	277,000	0.022	33.0
New Orleans, La.			
8/5-8/8-1963	161,000	0.074	64.0
9/6-9/12-1963	128,000	0.082	57.0
9/13-9/20-1963	119,500	0.083	54.0
10/2-10/8-1963	104,500	0.060	34.0
10/10-10/15-1963	101,000	0.134	73.0
10/23-10/28-1963	100,500	0.054	29.0
11/19-11/29-1963	113,000	0.019	12.0
12/9-12/14-1963	141,200	0.140	110.0
2/7-2/10-1964	223,700	0.102	120.0
2/19-2/24-1964	192,700	0.066	69.0

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* Estimate based on knowledge of general relationship to downstream flows.

The Endrin at Cape Girardeau, Missouri, which is reported in the table, for the 1963 sample was less than one pound per day. This value is supported by other values, presented in the Breidenbach report, for the previous five years, 1958 through 1962. In those years four of five values were negative, and one, in 1958, was 0.013 parts per billion (ppb), which probably represented 5 to 10 pounds per day. On this basis it may be concluded that the Mississippi River at Cape Girardeau normally does not carry detectable quantities of Endrin, but occasionally may carry up to a few pounds per day.

The West Memphis, Arkansas, sampling station is several miles below both tributary streams and municipal sewers in the Memphis area in which Endrin has been detected. Although the station is not ideally located to measure the effects of all wastes from Memphis, a sharp bend toward the Arkansas side does direct Memphis wastes toward the station. At this point the results show minimum values of 20, 23, and 140 pounds per day of Endrin. On the basis of these figures and consideration of data at downstream stations at Vicksburg and Delta it is concluded that the river at Memphis normally carries Endrin in the range of at least 20 to 30 pounds per day. The single high value of 140 pounds per day is accepted as valid for that period, but is believed to represent an abnormal occurrence rather than a usual load.

At Vicksburg, Mississippi, four results range from less than 0.8 to 60 pounds per day. Of the four, two are 20 and 29 pounds per day, again in the 20 to 30 pounds per day range, indicated at West Memphis.

At Delta, Louisiana, the single value available is 33 pounds per day, again near the 20 to 30 pounds per day range.

Thus, five of eight values at three sampling stations support a conclusion that the normal range of Endrin carried by the river below Memphis during the summer and fall months is 20 to 30 pounds per day, compared to usually negligible value at Cape Girardeau, Missouri.

At New Orleans results of 10 samples are available. These range from 12 to 120 pounds per day and average 62 pounds per day. The average of the six samples collected during the summer and fall months, and therefore nearly comparable to the results at the upstream stations, average 52 pounds per day. The four samples collected at New Orleans during the November through February period average 78 pounds per day.

The Endrin load at New Orleans does not include the Endrin from upstream which is carried in the water diverted to the Atchafalaya River at Old River. Measurements of this load are not available but based on the quantity of water diverted and the Endrin carried by the river upstream from Old River it is probable that a minimum of 5 pounds per day was diverted to the Atchafalaya.

Based on the foregoing considerations it is concluded that the Endrin carried by the Mississippi River at New Orleans is two to three times that carried by the river between Memphis and Vicksburg.

The data show conclusively that the Endrin carried by the river increases between Cape Girardeau and Memphis, and again between Vicksburg and New Orleans. The presence of a source of Endrin in the Memphis area, the Velsicol Corporation, has been established. Other sources cannot be identified at the moment.

There are several possibilities that may account for the increase that occurs between Vicksburg and New Orleans.

Seven sugar cane plants discharge wastes to the Mississippi River between Baton Rouge and Whitecastle, Louisiana. It is possible that those wastes contain some of the Endrin which was applied to the cane in the fields. The data at New Orleans, however, do not show greater quantities of Endrin during the mid-September through

December period when the sugar plants are operating than at other times of the year. Although a single value cannot be considered conclusive, the greatest load shown by any single result was in the period of February 7 through 10, 1964, when the sugar plants had been closed for a month or more.

I might cite that. I do not have it in the text at this point, but it was 120 pounds per day in February.

There is a possibility that surface run-off following rains on fields upstream from Louisiana that have been treated with Endrin may account for the increase. I say upstream from Louisiana because most of the Louisiana surface run-off is diverted from the river by the dike system and does not reach the river. There is some support for this possibility in the fact that the pounds per day of Endrin frequently, but not invariably, are greater for higher stream flows. The fact that there is not a consistent corrolation of those two factors is not surprising. The surface run-off from Endrin treated fields only would add to the Endrin content of the river. Many increases in flow of the Mississippi result from rainfall for removal from the cane fields.

Another possible source of the increase below Vicksburg is the sediment on the bed of the river. Endrin is readily absorbed by silt, and river bottom sediment may carry some of the material. Endrin may be leached slowly from such sediment, or the sediment itself may be picked up by increases in stream flow and the corresponding increases in velocities of flow. If the sediment pick-up alone were the cause, the greater pounds per day values would be expected to correlate more closely with higher stream flows than appears to be the case.

If a single or several constant sources of wastes, such as one or more manufacturing plants, were the only sources of Endrin, the pounds per day values in the flowing water would be expected to remain relatively constant, and the concentrations would be expected to decrease consistently with increasing stream flows. Neither of these conditions is reflected by the data.

In short, the available data do not identify all the sources of Endrin found at New Orleans. Further detailed study will be required to assess all potential sources of this material.

SUMMARY AND CONCLUSIONS

In the three upstream States, Arkansas, Tennessee, and Mississippi, only Vicksburg, Mississippi, is dependent on the Mississippi River for its source of municipal water supply.

In Louisiana more than 1,000,000 persons are served by water from the Mississippi and Atchafalaya Rivers and Bayou La Fourche.

The demonstrated presence of minute concentrations of Endrin in the finished water of the Vicksburg and New Orleans municipal supplies, and its probable presence in other Louisiana municipal supplies is a matter of concern. It is practically certain that acute effects of this toxicant have not resulted, but the possible effects of long-continued consumption of even minute traces of this poisonous material requires continuous close evaluation.

The sewage from nearly one and three-quarter million persons is discharged to the Mississippi River in the four States. Of this 86.4 percent, from nearly one and one-half million persons, is discharged without treatment.

Of the population discharging raw sewage, New Orleans discharges 56.6 percent and Memphis 32.1 percent. Together the two cities account for 88.7 percent of the total.

The most probable adverse effects of raw sewage discharges are aesthetic offenses and bacterial contamination which involves a health hazard to those using the river for recreation and to consumers of municipal water supplies in the event of failure of water treatment processes.

A total of 62 industrial plants discharge wastes directly to the Mississippi River, or to small tributary watercourses at points near the river.

Of this total 19 are situated in the Memphis metropolitan area, six in Mississippi, and 37 in the 200-mile reach of the river in Louisiana from St. Francisville to Oakville, below New Orleans.

Potential adverse effects of industrial wastes include aesthetic offenses, taste and odor in water supplies, taste and odor in fish, damage to biological forms, including fish, and the hazards to humans of long-term ingestion of water containing minute traces of toxic organic compounds, including Endrin.

With the exception of the results of accidental spills or other industrial accidents, which may be detected by conventional methods, it is probable that detailed evaluation of the potential damage of industrial wastes to water uses will involve new methods for the detection of almost infinitesimal quantities of a variety of organic compounds. The major sources of such compounds are petrochemicals and other synthetic organic chemicals.

The Velsicol Corporation plant at Memphis has been shown to be one of the sources of the Endrin found in the Mississippi River. The data demonstrates the existence of additional sources of Endrin between Vicksburg, Mississippi, and New Orleans, Louisiana, but do not reveal the identity of the sources. Possible sources are sugar cane factories in Louisiana, surface run-off from Endrin treated fields in States upstream from Louisiana, and river bottom sediment on which Endrin has been absorbed. Further detailed study will be required to identify the other sources and to evaluate methods of control.

Mr. Chairman, that completes my report.

SECTION G

APPENDIX

TABLE I

Lower Mississippi River

Mean Monthly Discharges

Discharge in Cubic Feet per Second

Month	Memphis	Vicksburg	Natchez	Tarbert Landing	Red River Landing	Baton Rouge
Jan.	515	591	563	582	473	452
Feb.	640	682	755	805	618	588
March	765	893	927	944	732	751
April	819	989	988	1008	799	814
May	645	856	870	878	720	748
June	516	670	651	671	561	552
July	424	547	520	509	421	444
August	280	358	366	358	282	274
Sept.	225	276	262	268	209	212
Oct.	217	274	270	278	210	208
Nov.	265	314	301	303	236	222
Dec.	349	418	387	380	309	293
MEAN ANNUAL DISCHG.	472	572	571	582	464	463
YEARS OF RECORD	23	23	24	24	29	16
DRAINAGE AREA(mi^2)	932,800	1,144,500	1,149,400	1,151,300	1,242,700	1,243,500

TABLE 2

Lower Mississippi River

Municipal Water Supplies

SUMMARY

Population Served in Four States	Estimated Population Served[1]
ARKANSAS	None
MISSISSIPPI[2]	41,000
TENNESSEE	None
LOUISIANA	1,093,705
TOTAL	1,134,705

SUPPLEMENT

Subdivision of Sources in Louisiana
By Water Works Districts and Subdistricts

	Estimated Population Served[1]	
	Population Served in Subdistricts	Total Population Served 3
STATE OF LOUISIANA		
I - Directly from Mississippi River		
BELLE CHASSE WATER WORKS DISTRICT		5,225
Belle Chasse	700	
BOOTHVILLE-VENICE WATER WORKS DIST.		2,400
Boothville	550	
Braithwaite	375	
Venice	500	
Subtotal	1,425	

TABLE 2

Lower Mississippi River

Municipal Water Supplies
(Cont'd.)

SUPPLEMENT

Subdivision of Sources in Louisiana
By Water Works Districts and Subdistricts

	Estimated Population Served [1]	
	Population Served in Subdistricts	Total Population Served [3]
STATE OF LOUISIANA(Cont'd.)		
I - Directly from Mississippi River(Cont'd.)		
BURAS EMPIRE WATER WORKS DIST.		10,855
Buras	3,000	
Empire	450	
Triumph	1,910	
Subtotal	5,360	
DALCOUR WATER WORKS DIST.		1,455
Bertrandville	100	
English Turn	60	
Subtotal	160	
DONALDSONVILLE		7,750
GRAMERCY		2,480
GRETNA		22,000
FREEPORT SULFUR CO. WATER PLANT		3,515
Port Sulfur Water Dist.	3,515	
Diamond	(200) [4]	
Nairn	(125)	
JEFFERSON PARISH WATER WORKS DIST. #1		145,300
Harahan	9,275	
Kenner	17,035	
Metairie	70,000	
Subtotal	99,825	

TABLE 2

Lower Mississippi River

Municipal Water Supplies
(Cont'd.)

SUPPLEMENT

Subdivision of Sources in Louisiana By Water Works Districts and Subdistricts

	Estimated Population Served[1]	
	Population Served in Subdistricts	Total Population Served[3]
STATE OF LOUISIANA(Cont'd.)		
I - Directly from Mississippi River(cont'd.)		
JEFFERSON PARISH WATER WORKS DIST. #2		40,915
Jefferson Parish Water Works No. 6	3,415	
Bataria	(900)	
Jefferson Parish Water Works No. 3	14,000	
Harvey	(10,000)	
Jefferson Parish Water Works No. 7	4,500	
Marrero	19,000	
Subtotal	40,915	
LUTCHER		3,440
NEW ORLEANS ALGIERS PLANT		326,065
NEW ORLEANS CARROLLTON PLANT		326,060
POINTE A LA HACHE WATER WORKS DISTRICT		1,030
Davant	415	
Pointe A La Hache	600	
Subtotal	1,015	

TABLE 2

Lower Mississippi River

Municipal Water Supplies
(Cont'd.)

SUPPLEMENT

Subdivision of Sources in Louisiana
By Water Works Districts and Subdistricts

	Estimated Population Served [1]	
	Population Served in Subdistricts	Total Population Served [3]
STATE OF LOUISIANA(Cont'd.)		
I - Directly from Mississippi River(Cont'd)		
ST. BERNARD PARISH WATER WORKS DIST. #1		35,000
Arabi	6,500	
Chalmette	15,000	
Meraux	500	
Violet	900	
Subtotal	22,900	
ST. BERNARD PARISH WATER WORKS DIST. #2		5,245
Saint Bernard	350	
ST. CHARLES PARISH WATER WORKS DIST. #1		10,000
Destrehan	330	
Montz	350	
New Sarpy	1,260	
Norco-Goodhope	4,680	
St. Rose	1,100	
Subtotal	7,720	

TABLE 2

Lower Mississippi River

Municipal Water Supplies
(Cont'd.)

SUPPLEMENT

Subdivision of Sources in Louisiana By Water Works Districts and Subdistricts

	Estimated Population Served[1]	
	Population Served in Subdistricts	Total Population Served[3]
STATE OF LOUISIANA (Cont'd.)		
I - Directly from Mississippi River (Cont'd.)		
ST. CHARLES PARISH WATER WORKS DIST. #2		11,255
Alemanos	1,165	
Ama	600	
Boutte	155	
Hahnville	1,295	
Luling	2,120	
Paradis	800	
Taft	260	
Subtotal	6,395	
ST. JAMES PARISH WATER WORKS DIST. #1		3,300
Convent	400	
Hester	200	
Paulina	1,150	
Union	640	
Subtotal	2,390	
ST. JAMES PARISH WATER WORKS DIST. #2		5,000
Vacherie	950	
Welcome	300	
Subtotal	1,250	

TABLE 2

Lower Mississippi River

Municipal Water Supplies

(Cont'd.)

SUPPLEMENT

Subdivision of Sources in Louisiana
By Water Works Districts and Subdistricts

	Estimated Population Served [1]	
	Population Served in Subdistricts	Total Population Served[3]
STATE OF LOUISIANA (Cont'd.)		
I - Directly from Mississippi River (Cont'd.)		
ST. JOHN THE BAPTIST PARISH WATER WORKS DIST. # 1		5,295
Reserve	5,295	
ST. JOHN THE BAPTIST PARISH WATER WORKS DIST. #2		2,460
Edgard	750	
Lucy	725	
Wallace	130	
Subtotal	1,605	
ST. JOHN THE BAPTIST PARISH WATER WORKS DIST. #3		7,175
Garyville	2,390	
La Place (Source 2)	3,540	
Lions	450	
Mount Airy	500	
Subtotal	6,880	
WESTWEGO		12,500
Jefferson Parish Water Works Dist. #5	6,000	
	210,185	
SUBTOTAL - DIRECT FROM MISSISSIPPI RIVER		995,720

TABLE 2

Lower Mississippi River

Municipal Water Supplies

Using Atchafalaya River as Source of Supply

SUPPLEMENT

Subdivision of Sources in Louisiana
By Water Works Districts and Subdistricts

	Estimated Population Served [1]	
	Population Served in Subdistricts	Total Population Served[3]
STATE OF LOUISIANA (Cont'd.)		
II - Mississippi River via		
ATCHAFALAYA RIVER		
BERWICK		6,000
St. Mary Parish Water Works Dist. #2	2,500	
MORGAN CITY		15,000
St. Mary Parish Water Works Dist. #1	900	
St. Mary Parish Water Works Dist. #3	1,150	
Subtotal	2,050	
PATTERSON		2,950
ST. MARY PARISH WATER WORKS DIST. #5		2,400
Centerville	600	
Garden City	300	
Subtotal	900	
ST. MARY PARISH WATER WORKS DIST. #6		3,500
Charenton	700	
	6,150	
SUBTOTAL VIA ATCHAFALAYA RIVER		

TABLE 2

Lower Mississippi River

Municipal Water Supplies

Using Bayou La Fourche As The Source Of Supply

SUPPLEMENT

Subdivision of Sources in Louisiana
By Water Works Districts and Subdistricts

	Estimated Population Served [1]	
	Population Served in Subdistricts	Total Population Served[3]
STATE OF LOUISIANA (Cont'd.)		
III - Mississippi River via		
BAYOU LA FOURCHE		
ASSUMPTION PARISH WATER WORKS DIST. #1		15,000
Bellerose	300	
Klotzville	300	
Labadieville	650	
Napoleonville	1,150	
Paincourville	500	
Plattenville	300	
Supreme	250	
Subtotal	3,450	
LA FOURCHE PARISH WATER WORKS DIST. #1		35,000
Cut Off	700	
Galliano	950	
Gheens	100	
Golden Meadow	3,095	
Grand Isle	2,075	
Kraemer	450	
Larose	2,795	
Mathews	200	
Raceland	3,665	
Subtotal	14,030	

TABLE 3

Lower Mississippi River

Sources of Sewage

MUNICIPALITY	TREATMENT	SEWERED POPULATION
ARKANSAS		
Elaine	Stabilization Pond	650
Helena	Stabilization Pond	9,200
Luxora	None	1,000
Marion	Primary	800
Osceola	None	5,000
West Memphis	None	5,000
TENNESSEE		
Memphis	None	475,524
Tiptonville	None	2,000
MISSISSIPPI		
Greenville	None	40,000
Natchez	None	20,000
Vicksburg	None	27,000
LOUISIANA		
Baton Rouge	Primary and Chlorination	193,485
Beechwood	Secondary and Chlorination	600
Brookstown	Secondary and Chlorination	1,500
Greendale	Secondary and Chlorination	350
Carville	Secondary and Chlorination	515
Chamiette	Primary and Chlorination	9,000
Donaldson	None	5,900
Gretna	None	21,000
Jackson		
E. La. State Hosp.	Secondary and Chlorination	4,000

TABLE 3

Lower Mississippi River

Sources of Sewage

(Cont'd.)

MUNICIPALITY	TREATMENT	SEWERED POPULATION
LOUISIANA (Cont'd.)		
Lake Providence	None	4,000
New Orleans	None	840,000
New Roads	None	3,975
Plaguemine	None	7,660
No. Plaguemine	Primary and Chlorination	1,000
Port Sulfur-Potash	Septic Tank	500
St. Bernard San. Dist	Primary and Chlorination	11,300
Vidalia	None	3,250
	Total -	1,716,159

TABLE 4

Lower Mississippi River

Summary of Sewage Sources

	Sewered Population				
	TOTAL		RAW		
STATE	Number	Per Cent of Total All States	Number	Per Cent of State Total	Per Cent of Total All States
ARKANSAS	21,600	1.26	11,000	52.4	0.74
TENNESSEE	499,524	29.11	499,524	100	33.68
MISSISSIPPI	87,000	5.07	87,000	100	5.86
LOUISIANA	1,108,035	64.56	885,785	79.9	59.72
TOTAL	1,716,159		1,483,309		86.4

TABLE 5

Lower Mississippi River

Sources of Industrial Wastes

STATE	MUNICIPALITY	INDUSTRY	TYPE
ARKANSAS		NONE	
TENNESSEE	MEMPHIS	E. I. DuPont de Nemours & Co., Inc.	Chemicals
		W. R. Grace & Co.	Synthetic Nitrogen Compounds
		Union Carbide Olefins Co.	Calcium Carbide
		Montana Ferro Alloys Co.	Metals
		International Harvester Co.	Foundry & Metals
		Linde Air Products Co.	Acetylene & Other Gases
		Virginia Carolina Chemicals Co.	Fertilizer
		Forest Products Chemical Co.	Wood Distillation Products
		Velsicol Chemical Corp.	Pesticides (Cooling Water)
		Kimberly-Clark Corp.	Paper
		The Humko Co.	Vegetable Oil Products
		Firestone Tire & Rubber Co.	Tires
		E. L. Bruce Co.	Wood Products (Including Impregnation)

TABLE 5

Lower Mississippi River

Sources of Industrial Wastes
(cont'd)

STATE	MUNICIPALITY	INDUSTRY	TYPE
TENNESSEE	MEMPHIS	The Humko Chemical Co.	Vegetable Oil Products
		Memphis Container Co.	Metal Drum Cleaning
		American Finishing Co.	Textiles
		Delta Refining Co.	Oil Refining
		Chapman Chemical Co.	Pesticide Formulation
		Vaccinol Chemical Co.	Pesticide Formulation
MISSISSIPPI	GREENVILLE	U. S. Gypsum Co.	Insulation & Hard Board
	VICKSBURG	American Metals Climax, Inc. Southwest Potash Division	Inorganic Chemicals
		Spencer Chemical Co.	Synthetic Nitrogen Compounds
		Westinghouse Electric Corp.	Electrical Fixtures
	NATCHEZ	International Paper Co.	Pulp & Paper
		Johns-Manville Products Corp.	Insulating Board

TABLE 5

Lower Mississippi River

Sources of Industrial Wastes (cont'd)

STATE	MUNICIPALITY	INDUSTRY	TYPE
LOUISIANA	ST. FRANCISVILLE	Princeville Canning Co.	Canning
		Crown Zellerbach Corp.	Pulp & Paper
	SCOTS BLUFF	U.S. Rubber Co.	
		Naugatuck Chemical Division	Petrochemical
	BATON ROUGE	Allied Chemical Corp.	
		General Chemical Division	Organic & Inorganic Chemicals
		Solvay Division	Inorganic Chemical
		Copolymer Rubber & Chemical Div.	Petrochemical
		Ethyl Corp.	Organic & Inorganic Chemical
		Foster Grant Co.	Petrochemical
		Humble Oil & Refining Co.	Oil Refining & Petrochemical
		Ideal Cement Co.	Cement
		Kaiser Aluminum & Chemical Corp.	Alumina & Inorganic Chemicals
		U. S. Rubber Co., Naugatuck Chem. Div.	Petrochemical
		W. F. Grace & Co., Polymen Chem. Div.	Petrochemical & Plastics
	LOBDELL	Catherine Sugar Factory	Cane Sugar
	PORT ALLEN	Smithfield Sugar Factory	Cane Sugar
		Poplar Grove Sugar Factory	Cane Sugar
		Cinclare Sugar Factory	Cane Sugar

TABLE 5

Lower Mississippi River

Sources of Industrial Wastes
(Cont'd.)

STATE	MUNICIPALITY	INDUSTRY	TYPE
LOUISIANA	PLAQUEMINE	Dow Chemical Corp.	Organic & Inorganic Chemical
	BAYOU GOULA	Catherine Sugar Factory	Cane Sugar
	WHITE CASTLE	Cedar Grove Sugar Factory	Cane Sugar
	GEISMAR	Goliad Corp.	Petrochemical
		Borden Chemical Co.	Petrochemical
		Monochem Co.	Petrochemical
		U. S. Rubber Co., Naugatuck Chem. Div.	Petrochemical
		Wyandotte Chemical Co.	Petrochemical
	GRAMERCY	Kaiser Aluminum & Chemical Corp.	Alumina & Organic Chemicals
	EDGARD	San Francisco Sugar Factory	Cane Sugar
	NORCO	Shell Chemical Corp.	Petrochemicals
	LULING	Monsanto Chemical Corp.	Nitrates & Fertilizers
	MARRERO	Allied Chemical Corp., General Chem.Div.	Organic & Inorganic Chemicals
		Johns-Manville Corp.	Wallboard, Masonite, etc.
	NEW ORLEANS	Wesson Oil & Snowdrift Co., Inc.	Vegetable Oil Products

TABLE 5

Lower Mississippi River

Sources of Industrial Wastes
(Cont'd.)

STATE	MUNICIPALITY	INDUSTRY	TYPE
LOUISIANA	HARVEY	Swift & Co.	Meat Products
	CHALMETTE	Ingram Oil & Refining Co.	Oil Refining
		Kaiser Aluminum & Chemical Corp.	Aluminum Smelting
	MERAUX	Murphy Corp.	Oil Refining
	OAK POINT	California Chemical Corp., Oronite Div.	Petrochemical & Inorganic Chemicals

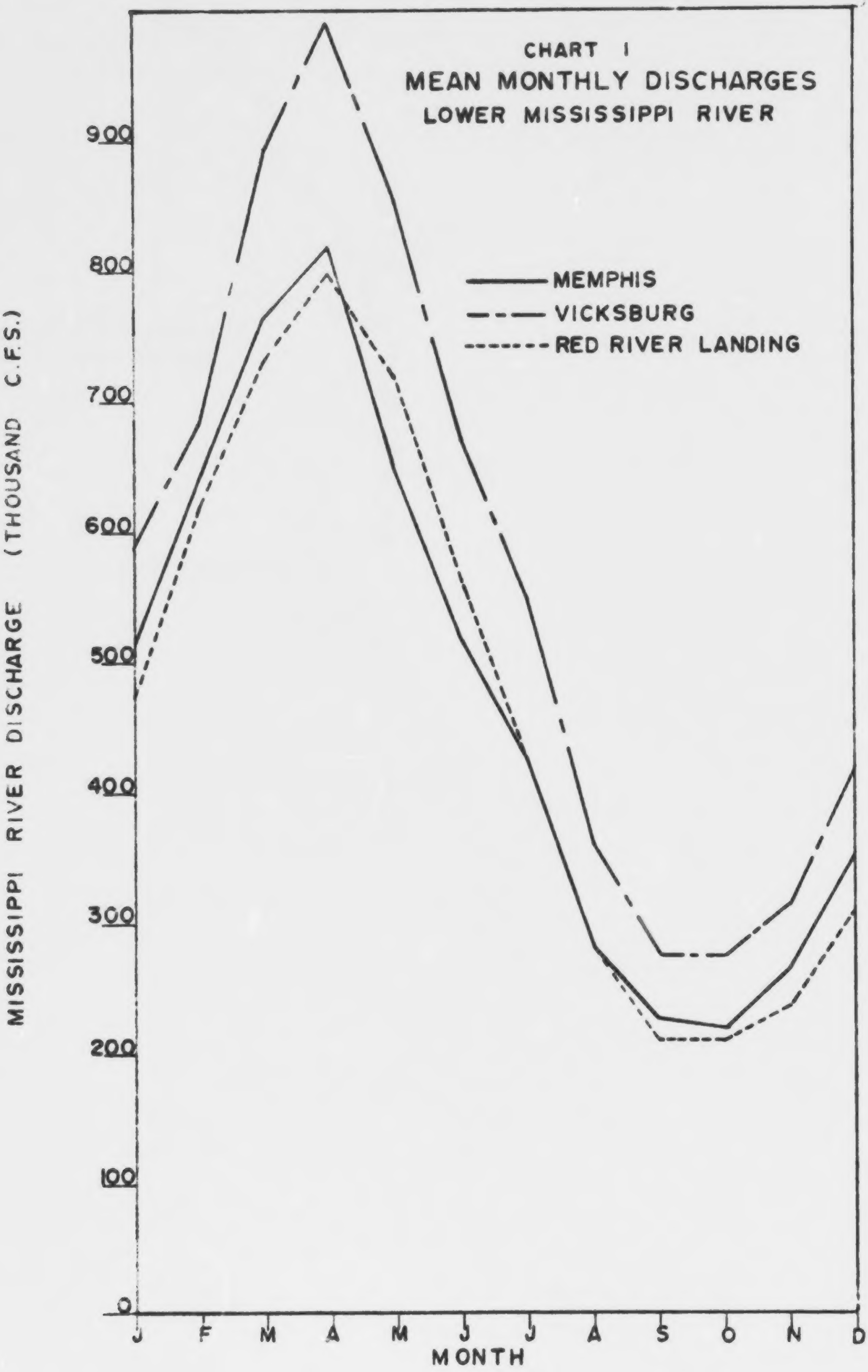


CHART 1
MEAN MONTHLY DISCHARGES
LOWER MISSISSIPPI RIVER
MEMPHIS
VICKSBURG
RED RIVER LANDING
MISSISSIPPI RIVER DISCHARGE (THOUSAND C.F.S.)
900
800
700
600
500
400
300
200
100
0
J
F
M
A
M
J
J
A
S
O
N
D
MONTH

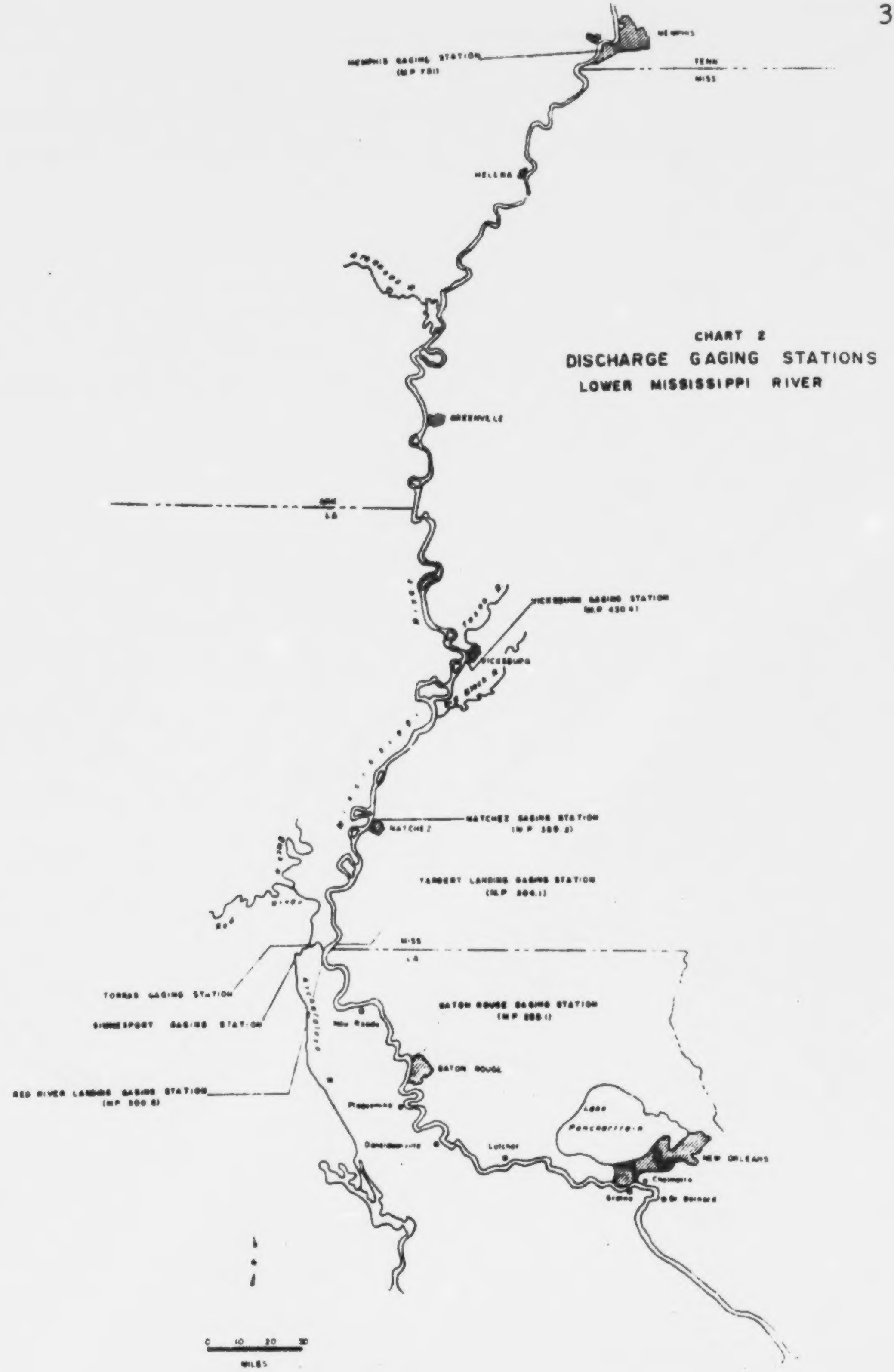


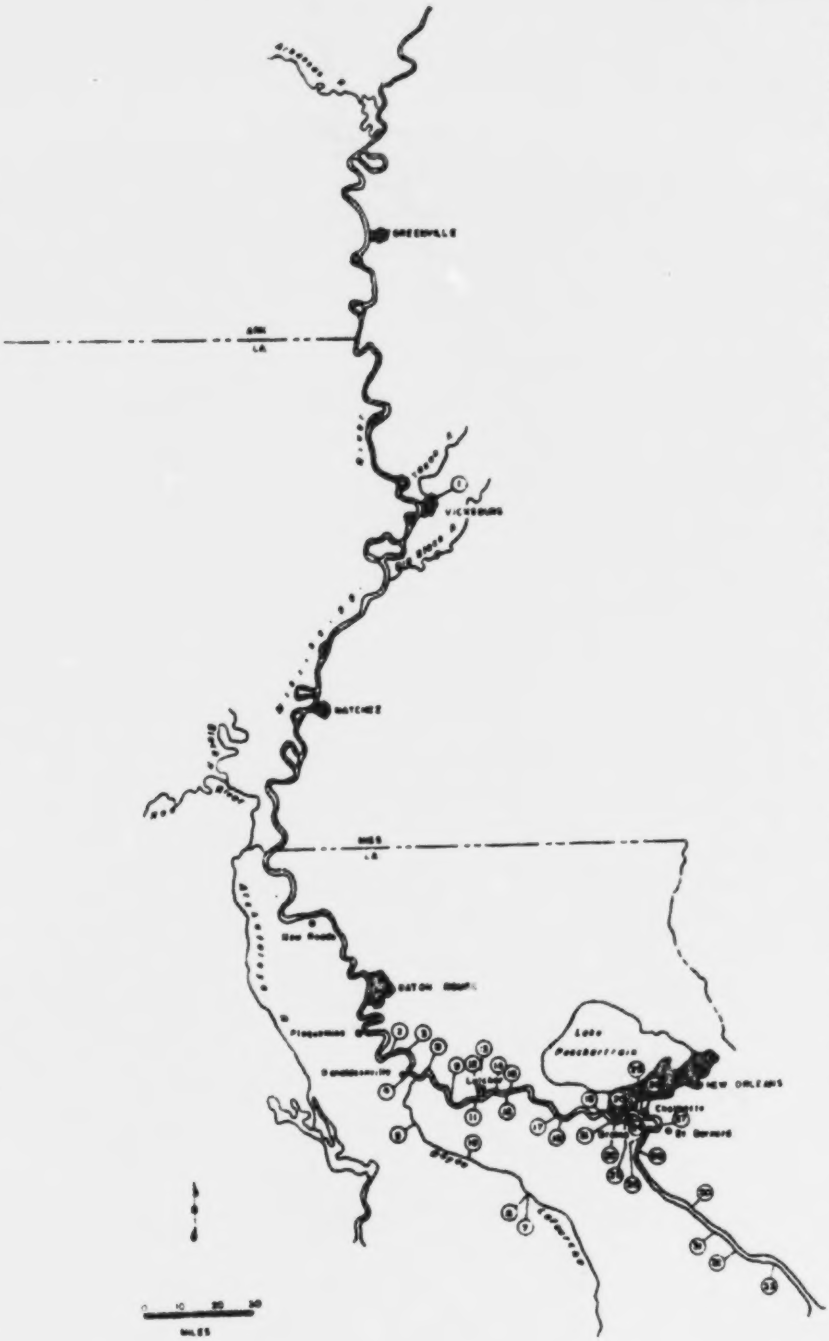
CHART 2
DISCHARGE GAGING STATIONS
LOWER MISSISSIPPI RIVER

MEMPHIS
MEMPHIS GAGING STATION
(M.P 781)
TENN
MISS
HELENA
ARKANSAS R
GREENVILLE
ARK
LA
YAZOO R
VICKSBURG GAGING STATION
(M.P 430.4)
VICKSBURG
BIG BLACK R
MISSISSIPPI
NATCHEZ GAGING STATION
(M.P 363.3)
NATCHEZ
TARBERT LANDING GAGING STATION
(M.P 306.1)
Red River
MISS
LA
TORRAS GAGING STATION
SIMMESPORT GAGING STATION
Atchafalaya
New Roads
BATON ROUGE GAGING STATION
(M.P 233.1)
BATON ROUGE
RED RIVER LANDING GAGING STATION
(M.P 300.5)
Plaquemine
Donaldsonville
Lutcher
Lake
Pontchartrain
NEW ORLEANS
Chalmette
Gretna
St Bernard
0 10 20 30
MILES

CHART 3

SOURCES OF WATER SUPPLY

LOWER MISSISSIPPI RIVER


Greenville
ARK
LA
Yazoo R.
Vicksburg
Big Black R.
Natchez
Red River
MISS
LA
Atchafalaya River
New Roads
Baton Rouge
Plaquemine
Donaldsonville
Lake Pontchartrain
New Orleans
Chalmette
St. Bernard
Bayou Lafourche
0 10 20 30
MILES

LEGEND

1. Vicksburg, Miss.
2. U. S. Public Health Service Hospital, Carville, La. ([illegible])
3. Wyandotte Chemical Co., Geismar, La. (18[illegible])
4. Peoples Water Service Co., Inc., Donaldsonville, La. (17[illegible])
5. Assumption Parish W. W. Dist. [illegible], Napoleonville, La.
6. Lafourche Parish W. W. Dist. [illegible], Lockport, La.
7. Lockport Water Treatment Plant
8. Ormet Corp., Burnside, La. (171.[illegible])
9. St. James W. W. Dist. #1, Convent, La. (156.[illegible])
10. City of Thibodaux Water Plant, Thibodaux, La. (151.8)
11. St. James W. W. Dist. #2, Vacherie, La. (151.7)
12. Colonial Sugars Co., Gramercy, La. (147.2)
13. Gramercy Water Plant, Gramercy, La. (147.2)
14. St. John W. W. Dist. #3, Lions, La. (142.6)
15. St. John W. W. Dist. [illegible], Edgard, La. (140.8)
16. National Sugar Co., Reserve, La. (140)
17. St. Charles Parish W. W. Dist. [illegible], New Sarpy, La. (12[illegible])
18. St. Charles Parish W. W. Dist. #2, Luling, La. (122.4)
19. Jefferson Parish W. W. Dist. [illegible], Metairie, La. (107)
20. Carrollton Plant, New Orleans, La. (105.4)
21. City of Westwego Water Dist., Westwego, La. (103.4)
22. Jefferson Parish W. W. Dist. #2, Marrero, La. (100.4)
23. City of Gretna Water Dist., Gretna, La. (99.[illegible])
24. Algiers Plant, New Orleans, La. (97.[illegible])
25. The American Sugar Refining Co., New Orleans, La. (92.[illegible])
26. Kaiser Aluminum & Chemical Corp., Chalmette, La. (9[illegible])
27. St. Bernard W. W. Dist. [illegible], Chalmette, La. (89.[illegible])
28. Dalcour W. W. Dist., Braithwaite, La. (7[illegible])
29. Belle Chasse Water Dist., Belle Chasse, La. (77.8)
30. Pointe-a-la-Hache Water Works, Pointe-a-la-Hache, La. ([illegible]1.4)
31. Freeport Sulphur Co., Port Sulphur, La. (41.[illegible])
32. Buras Waterworks Dist., Empire, La. (31.5)
33. Boothville Venice Water Works, Venice, La. (20.[illegible])

Note: Numbers in parentheses are approximate distances in miles from the Gulf of Mexico.

CHART 8

SOURCES OF SEWAGE

LOWER MISSISSIPPI RIVER

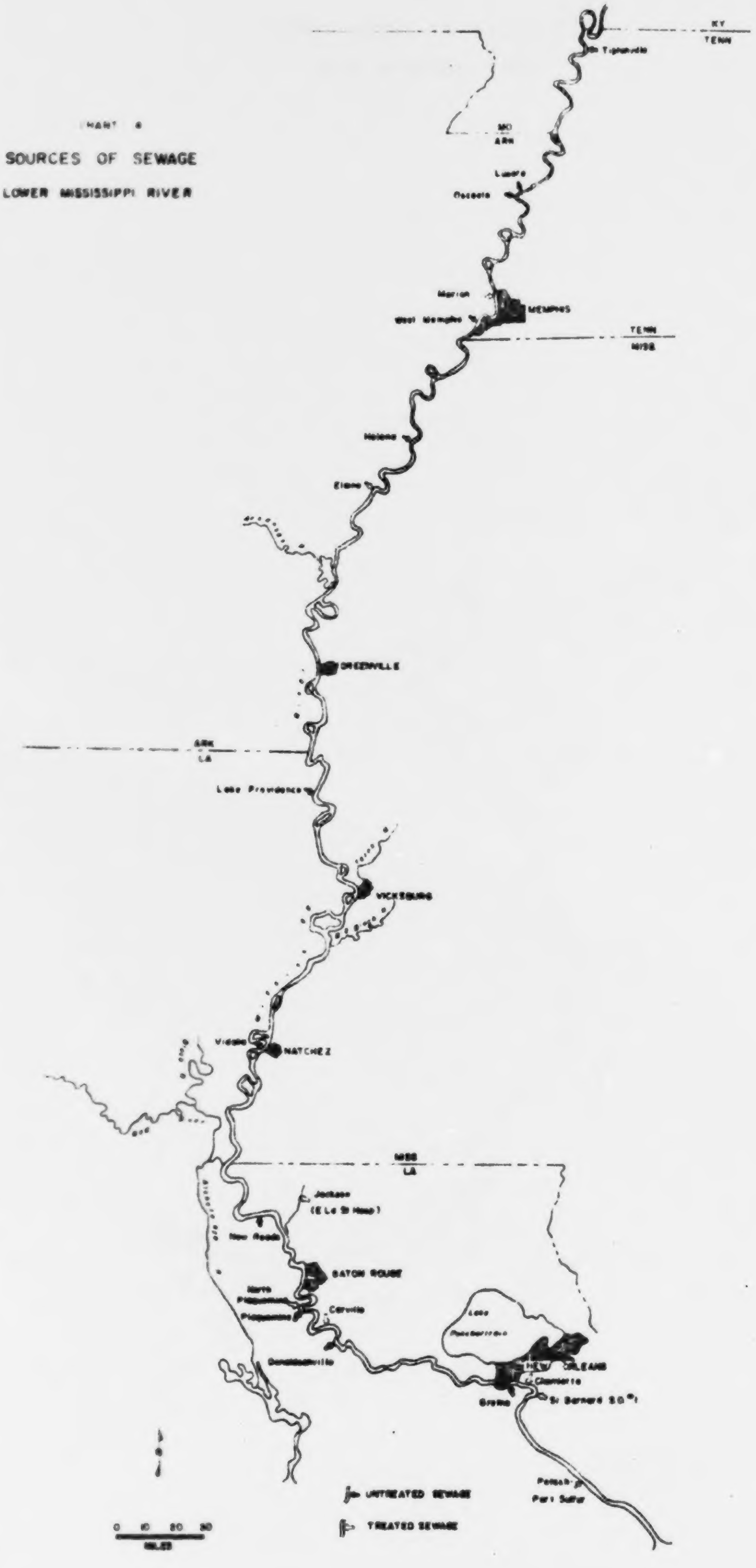
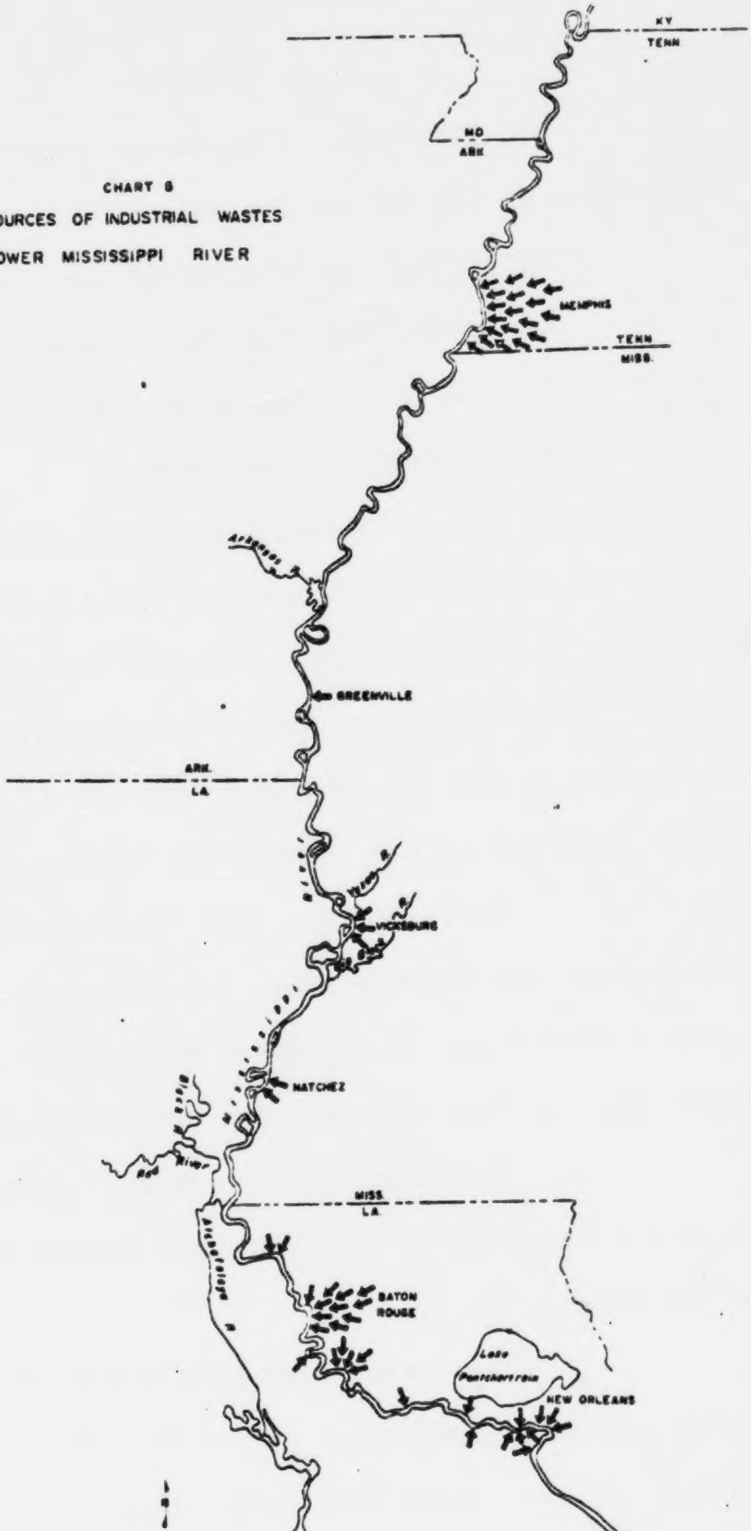

KY
TENN
Tiptonville
MO
ARK
Luxora
Osceola
Marion
MEMPHIS
West Memphis
TENN
MISS
Helena
Elaine
GREENVILLE
ARK
LA
Lake Providence
VICKSBURG
Vidalia
NATCHEZ
MISS
LA
Jackson
(E La St Hosp)
New Roads
BATON ROUGE
North Plaquemine
Plaquemine
Carville
Donaldsonville
Lake Pontchartrain
NEW ORLEANS
Chalmette
Gretna
St Bernard S.D.#1
Pointe-a-la-Hache
Port Sulfur
UNTREATED SEWAGE
TREATED SEWAGE
0 10 20 30
MILES

CHART 8

SOURCES OF INDUSTRIAL WASTES

LOWER MISSISSIPPI RIVER


KY
TENN
MO
ARK
MEMPHIS
TENN
MISS.
Arkansas R.
GREENVILLE
ARK.
LA.
Yazoo R.
VICKSBURG
Mississippi
NATCHEZ
Red River
MISS.
LA.
Atchafalaya R.
BATON ROUGE
Lake Pontchartrain
NEW ORLEANS
0 10 20 30
MILES

MR. KITTRELL: I would now like to read the conclusions at the end of the report.

MR. STEIN: At the end of the entire report?

MR. KITTRELL: That is correct.

MR. STEIN: Go ahead, Mr. Kittrell.

MR. KITTRELL: Conclusions.

1. The pesticide Endrin was responsible for the fish kill observed in the Mississippi and Atchafalaya Rivers, in Louisiana, during the fall and winter of 1963-64.

2. Industrial wastes and drainage from contaminated areas in and near Memphis, Tennessee, are sources of Endrin pollution in the Mississippi River.

3. The available data demonstrate that other sources than the Memphis area, not yet identified, contribute to the Endrin found in the Lower Mississippi drainage area. These other sources must be identified through further study.

4. Discharges of sewage and industrial wastes may cause pollution of an interstate nature and will require further study.

5. The presence of minute concentrations of Endrin in the treated water of the Vicksburg, Mississippi, and New Orleans, Louisiana, water supplies is a matter of concern. While acute effects on humans of this pesticide in water have not been detected the effects of continued

ingestion of even these minute quantities must be evaluated.

6. It is obvious that discharges of Endrin in the Memphis, Tennessee area, together with other identified discharges endanger health and welfare of persons in a State or States other than that or those in which such discharges originate. Such discharges are subject to abatement under the provisions of the Federal Water Pollution Control Act.

MR. STEIN: There seem to be an obvious typographical error in your conclusions, and I think it is important.

Where you say "other than that or those" and maybe that should be "health or welfare."

MR. KITTRELL: I believe the "or" is correct. Not knowing the source of Endrin, we can't say it was one or several.

MR. STEIN: If you mean "or" that is your report. I thought you were quoting from the statute here. The statute says "of." If you want to say "or," this is your report, Mr. Kittrell.

MR. KITTRELL: You have lost me a little. Are you talking about --

MR. STEIN: "In a state or states other than that of those." I don't think "or" makes sense.

MR. Jones: Maybe it doesn't come out of the statute.

MR. STEIN: It says so in the next sentence.

MR. KITTRELL: I will strike out "or those."

MR. STEIN: Change "other than that or those" to "of those."

MR. KITTRELL: All right.

MR. STEIN: All right.

Do we have any comments or questions?

MR. LAFLEUR: I do.

MR. STEIN: Yes.

MR. LAFLEUR: Mr. Kittrell, in the second line of your No. 6 conclusions, you have, "It is obvious that discharges of endrin in the Memphis, Tennessee area, together with other identified discharges..."

MR. KITTRELL: I think that should be "unidentified." I think that is the whole problem. That should be "unidentified." That is a typographical error there.

MR. STEIN: Very good. Thank you.

Are there any other comments or questions? Go ahead?

MR. ALBARES: I have one question to ask Mr. Kittrell here, if I may.

There seems to be some conflict in testimony and maybe you can straighten me out on it.

In Table 3, Dr. Breidenbach shows a greater concentration of Endrin at New Orleans in 1962 than in 1963 at the low flow, and yet the fish kills reported by Mr. Biglane were substantially less in 1962 than in 1963.

Doesn't this suggest that something else other than Endrin is responsible, or at least contributes heavily to the kill of fish in the Lower Mississippi?

You mentioned other things, and I just wondered if you could elaborate on that in your report.

MR. KITTRELL: You mean the possibility of other fish kills?

MR. ALBARES: And what they may be.

MR. KITTRELL: I had primarily in mind the possibility of industrial spills, rather than the continued industrial discharges. Industrial accidents, in other words, are what I had in mind there.

MR. ALBARES: Thank you.

MR. STEIN: Does that answer your question?

MR. ALBARES: Yes.

MR. STEIN: All right.

MR. WOOD: There is frequently a problem of percentages when you are dealing with mixtures of various types of waste, whether they are organic or inorganic, and

I don't seem to find any reference to any of that in any of the data presented here.

Of course, you have already commented on this question here which alluded to it, though not specifically in terms of percentages and an antagonistic effect. I just wondered if you would have any comment on that at this time.

MR. KITTRELL: I am afraid I would have to refer those questions to the biologists, the fish people, and possibly the chemists.

MR. STEIN: All right. Who do you think would be qualified to answer that? Dr. Mount?

MR. KITTRELL: Dr. Mount.

MR. STEIN: Dr. Mount, would you come up?

I think it might be wise on these general questions, Dr. Mount, if you came up with Mr. Kittrell, and as to the ones where you feel you want to call someone else, call on the appropriate person.

DR. MOUNT: I could only say, in regard to this question that you have asked, that we are not unaware of these problems, and I can only say what I have already said.

I think that our data shows simply that there was enough Endrin in the blood of these fish to have caused death.

We are not saying that other things could not have contributed to it, but it seemed, and in all probability indicated, that there was enough Endrin there to do it, and that we need not look for further causes.

MR. JONES: Wait a minute. That doesn't tie together.

DR. MOUNT: I think, sir, that it does, in the fact that the values of Endrin in the blood of fish taken from the river are very closely related -- excuse me. The content of Endrin in the blood of fish taken from the Mississippi River correlates very closely with whether the fish were dying or not.

I pointed out this morning that buffalo that were taken during the time of the kill had Endrin concentrations -- I do not recall the exact figures now, but in the range of two-tenths of a part per million; whereas after the kill had subsided, there was no Endrin, detectable quantity of Endrin, in the blood of the fish.

Likewise, in regard to the catfish, we had concentrations ranging from .4 to .56 parts per million of Endrin while the fish were dying -- that is, taken from dying fish -- whereas after the kill had subsided in late February, the concentrations were in the range of .1 parts per million of Endrin.

MR. JONES: Isn't there a table somewhere in here -- I don't know which one of them -- that shows far more Endrin than you are talking about with the fish being happy and content, or whatever fish are?

DR. MOUNT: We have living fish which had Endrin concentrations in the blood as high as approximately two-tenths of a part per million.

A VOICE FROM THE FLOOR: That is on Page 33, Leary.

DR. MOUNT: Most of those fish were from experimental exposure -- I won't say most of them. Some of them would have died at later dates, because the concentration in the water was high enough to kill them.

I would call your attention to the last figures in Table 1 in the report, and there you will see exposure of 44 days' duration at various concentrations of Endrin, and you will note that it is only when we approach the lethal water concentration that the blood levels begin to rise.

As I recall, these values at the low water concentrations of Endrin were in the range of .07 parts per million in the blood, whereas in the two fish which were still living, there was a concentration of .5 parts per billion in the water. There the Endrin blood concentration was rising. These fish were on the verge of convulsions.

I would like also at this point, since this has been raised, to call your attention to another table which Dr. Breidenbach has in his report.

MR. STEIN: Identify the page, if you will.

DR. MOUNT: I will find it. I am referring, if you can help me find it, to the concentrations of Endrin measured at New Orleans.

It is Chart 5.

MR. STEIN: What page is that?

DR. MOUNT: It immediately precedes Page 59. I guess it is 58.

MR. STEIN: All right.

DR. MOUNT: If you look there at Chart 5 in the bottom right-hand corner, you will see the Endrin concentrations which he found at New Orleans for 1958 through 1963, and I would call your attention to the close relationship between the amount of Endrin found in the years of the fish kills.

Now, I think we must realize, and this has been pointed out several times, that these are minimum concentrations and that, in fact, they may have been ten times as high.

Therefore, it is not surprising that the exact concentration of Endrin as determined here would correlate exactly with the fish kill.

MR. STEIN: I would like to make one comment.

Normally, through the years, I have had maybe a really simple way or simple mind of looking at this. As I understand Dr. Mount, he says there is sufficient Endrin in the blood of the fish to kill the fish. He said they killed the fish. I have no conclusion yet pending other statements on this, however. He also says that they kill them alone without a synergistic action.

I don't go along with the notion that we don't have to look for anything else, but we will move slow and easy, and if they do kill the fish I am content to remove one poison at a time, and then we will go on from there.

MR. ALBARES: May I ask a question?

MR. STEIN: Yes.

MR. ALBARES: Dr. Mount, do you have your booklet in front of you, or your presentation, Pages 33, 34, 35 and 36? I think I missed some of this this morning in your presentation. Will you please just very briefly refresh my memory?

Beginning on Page 33, that is catfish you got from Arkansas to determine the Endrin content that it takes to kill them. Is that correct?

DR. MOUNT: Yes.

MR. ALBARES: And, Table 2, Percent recovered of

Endrin from blood as indicated from your studies.

Now, moving on to Table 3, I notice there, if I am adding this correctly, in your sample of blood concentration of Endrin in dying Mississippi River fish, all your determinations with regard to channel catfish were made from eight samples. Is that correct?

DR. MOUNT: That is correct.

MR. ALBARES: And tabulated into the millions we are talking about here. Am I understanding that right?

Let's see -- 8 channel catfish, 1 bullhead, 1 blue catfish, 2 buffalo and approximately 20 shads?

DR. MOUNT: That is correct.

I refer you, as far as my comments about that are concerned, to the discussion in the text about the probabilities involved in this sampling.

We realize that these are limited samples. We also realize that 5,000 gallons of water from the Mississippi River is a limited sample. This is all we have and this is what we have used.

I have used straightforward statistics to show you the probability of picking up this many consecutive fish with lethal concentrations of Endrin in their blood.

MR. ALBARES: Has any attempt been made to collect additional samples as a follow-up to this, or is this the most recent to determine whether or not this is still continuing? That is what I am trying to find out.

DR. MOUNT: My understanding from Mr. Lafleur and others from Louisiana is that the kill substantially did subside after we left, with a few minor outbreaks.

Is that right?

MR. LAFLEUR: The last reported kill that we heard about, observed and investigated, occurred in the latter part of the first week of February or the early part of the second week of February of 1964.

DR. MOUNT: I would like to add, sir, one point on that.

We have examined the muscle contents for Endrin in approximately 20 other channel catfish other than the ones listed in Table 3, and the muscle concentrations were in a very similar range, namely, about a half to one and a half parts per million.

This data cannot be used as critically as can the blood concentrations, because we realize that there may be some storage of Endrin in the muscle, but the generally similar concentrations of Endrin in the muscle of these 20 fish -- that is, similar to the 8 fish listed -- would indicate that the same general picture prevailed.

We do feel, and we have some data to indicate, that muscle is not a primary storage area, and therefore you would not expect storage in the muscle.

MR. ALBARES: Thank you.

MR. STEIN: Because this is relatively complicated, let me throw this out. This may be the time to uncomplicate it.

I think the question which you have is a very good one. That is on the relatively limited number of samples of fish he took. Of course, he had a much larger number of samples in the laboratory, about 100, but still that is limited.

This question -- and we have this in many areas of not only scientific proof, but other proof -- is dealing with the permutations and combinations. You have to determine the likelihood of Dr. Mount picking up 10 fish in a row where he found certain levels of Endrin in the blood, examining them as an experienced aquatic biologist, noting their symptoms, convulsions, as he said, and abdominal distention, and then reproducing this in a laboratory with another 100 fish and finding the same levels of Endrin, or about the same levels of Endrin, and observing the same symptoms.

The likelihood of that happening is the question. This is just like, and I think we have this many, many times, in fields like astronomy, where someone does calculations and says there is another planet or another star. They point a telescope to the sky and there it is. The likelihood of their just picking this spot out on this night is remote.

I think this is the kind of proof that we have to relate ourselves to.

The reason I bring it out here is I think this needs some thought perhaps before we come to a conclusion.

MR. WOOD: Murray?

MR. STEIN: Yes.

MR. WOOD: The point was made that it was entirely possible that there was as much as ten times the concentrations extracted by the carbon filter technique rather than the amount indicated.

Just as a matter of guesswork, has anybody figured up the probability that all this extraction -- I think the carbon filters run over a period of seven to ten days to acquire a 5,000-gallon sample. Simply then, what is the probability that a slug came down and all this has accumulated over seven to ten days, and it actually happens over one or two days?

DR. MOUNT: Do you want to answer that, Dr. Grzenda?

MR. STEIN: Dr. Grzenda, do you want to take that?

DR. GRZENDA: As I understand it, sir, you are asking whether or not anybody has taken into consideration the probability that a slug comes down and sweetens up the carbon filter, and then goes on by?

MR. WOOD: That is right. The fish kills don't occur every day in the year.

DR. GRZENDA: That's right.

MR. WOOD: We don't have daily samples from these points. You are having the carbon filter data, which is an accumulation of X days representing 5,000 gallons in toto.

DR. GRZENDA: That's right. It takes anywhere from seven to ten days to get the 5,000-gallon sample at half a gallon per minute.

Therefore, if we assume, for example, the slug comes down the river and really puts a load on the carbon filter and that the concentration thereafter until the end of the seven-day period is much, much lower, then we have to conclude that the value we get, the concentration is really an average integrated value.

MR. WOOD: That is correct.

DR. GRZENDA: And, indeed, at one time during that it could have been much, much higher.

MR. WOOD: Or lower.

DR. GRZENDA: And at other times it could have been much, much lower.

MR. WOOD: Yes.

DR. GRZENDA: So, in essence, we have to say that it is an average value for that time period.

MR. WOOD: Well, the point is there is some mention made here of sedimentation and the possibility of carrying this stuff along the sediment.

DR. GRZENDA: Yes.

MR. STEIN: I believe Dr. Mount may have a comment, if you don't mind.

MR. WOOD: I am just trying to find out whether you think this is occurring every day, day after day, or building up slowly.

DR. GRZENDA: Let's introduce this idea of total transport. I don't believe the words were mentioned. But as the river moves along, it isn't just water. Of course, suspended solids move with it, depending on how fast the water is moving, and what one collects in a grab sample is a mixture of materials absorbed in solids and those which are in a solution and those which are suspended. Consequently, also in a carbon filter sample we would expect a little bit of the same thing, although some of the solids may get on through. Some of them may be trapped.

These are reasons which support the idea that what we get from the carbon filter is a minimum concentration.

MR. WOOD: Well, the carbon has a tendency to load up if it is exposed to optimum conditions in concentrations of anything. Does it load up?

DR. ORZENDA: Oh, yes. It will load up. We do this in the laboratory, but carrying this out under field conditions is a horse of a different color.

Have I helped?

MR. STEIN: Dr. Mount, I believe, has a comment.

MR. WOOD: I am more confused.

DR. MOUNT: I think that some biological observations here may shed some additional light on this question that you have raised.

It was very apparent to me, although it was not possible to get a panoramic view of the pattern of this fish mortality at the time I was there, that the area of fish mortality did not seem to be related to the flow of the river.

For example, during the week that I spent at Baton Rouge, there were relatively few fish dying in the main channel of the river. The small navigation canal leading off the Mississippi River and immediately opposite Baton Rouge had large numbers of fish dying in it.

Now, this canal, if my understanding is correct, receives its total flow from the Mississippi River.

On the other hand, as I recall, the week before we had been there, at Baton Rouge there had been a substantial kill in the Mississippi River itself. We have already mentioned the menhaden kill which occurred down at Venice, I believe about two weeks before I was there.

The only point I am trying to make is that the areas of fish kill were not continuous over many, many miles, but they were spotty. They occurred here and there at different places, and this would tend to indicate that it was not closely related at least to a slug, or at least this would be my interpretation of this kind of mortality.

I think one other point should be raised here too, and that is that I know of no data which can tell us as yet whether insecticides adsorbed on the silt particles are or are not toxic. I don't think we necessarily have to assume that it must be in solution or something close to it in order to be toxic.

MR. WOOD: Do you have any theories on the route of entry into these fish insofar as any hydrocarbons go?

DR. MOUNT: You don't need to look at the table, but from the data in Table 1, you can see that the Endrin concentration in a matter of two and a half hours of exposure, or roughly two and a half hours, in a water concentration of forty parts per billion, was in the neighborhood of 1.8 parts per billion in the blood.

MR. WOOD: You indicated that it was absorbed by fish under static flow.

DR. MOUNT: Yes, but my observation here would be that it must be entering through the gills in order to get into the blood this rapidly.

It seems inconceivable that a fish would drink enough water in two and a half hours to put that kind of a concentration in his system.

MR. WOOD: Thank you.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: If not, thank you very much, Mr. Kittrell and Dr. Mount.

MR. TRYGG: Murray?

MR. STEIN: Yes.

MR. TRYGG: Just to get the record straight, there are two figures on the City of New Orleans, one on water connections or populations served by water, and one on sewer connections, served by sewage. One of them is 640,000 and the other is 840,000. There must be an error there. It should be 640,000 in each case, because there are only 640,000 people in New Orleans.

MR. KITTRELL: Well, my source of information was the Public Health Service inventory.

MR. TRYGG: I think there must have been an error. I hope it was an error made by the people typing it off our records.

MR. STEIN: Would you accept Mr. Trygg's correction?

MR. KITTRELL: Well, I would say that Mr. Trygg would know the situation a great deal better than I do.

MR. STEIN: I would hesitate to dispute Mr. Trygg on any figures of that kind in Louisiana. You may be braver than I am.

MR. TRYGG: I have confirmed that from the Superintendent of Sewage and Waterworks in the back of the room.

MR. STEIN: All right.

MR. KITTRELL: I would say, however, that it is not uncommon for there to be a difference in the sewered population and in the water-served, depending on the area covered by the two systems.

MR. STEIN: Let's go off the record.

(Discussion off the record.)

MR. STEIN: All right. Thank you.

MR. SVORE: If there are no further questions, I would like to call on Keith Krause, Chief of our Technical

Services Branch in Washington, D. C., who will present the conclusions.

STATEMENT OF KEITH S. KRAUSE, CHIEF,
TECHNICAL SERVICES BRANCH, UNITED
STATES PUBLIC HEALTH SERVICE,
WASHINGTON, D. C.

MR. KRAUSE: Mr. Chairman, conferees and ladies and gentlemen:

To attempt to summarize what you have heard here today in a few short words would be most difficult, but I shall try to bring this brief summary to you in this manner.

Responding to a request from the State of Louisiana for technical assistance in November of 1963, the Public Health Service carried out a number of investigation and laboratory studies that led to a determination of the cause of the major fish kill that occurred in the Lower Mississippi and Atchafalaya River Basins in the winter of 1963 and 1964. During periods of low flow the Atchafalaya River flow consists of approximately 90 percent diversion from the Mississippi River through the old river connection at Knox Landing, Louisiana.

Public Health Service scientists from the Sanitary

Engineering Center in Cincinnati, Ohio, visited the site, made on-the-site observations, took samples of dying fish, mud and water, and interviewed persons knowledgeable of the fish kill. Samples of mud, water and flesh of dying fish exhibited toxicity to test fish in the laboratory. Endrin was shown to be a common poison in all samples taken. Water samples from the Public Health Service Water Pollution Surveillance System showed measurable concentrations of Endrin from West Memphis, Arkansas, south to New Orleans, Louisiana, for the years 1958 through 1963. Other toxicants and biological agents, thought at first to be more logical causes of the kill, were ruled out by laboratory tests and experiments.

As a result of field observations and a series of notable experiments and examinations that revealed the presence of lethal levels of Endrin in the blood of every dying catfish examined, already described to you, the Public Health Service concluded that Endrin was the cause of the fish kill in the winter of 1963 and 1964. The Department of Health, Education, and Welfare has made this conclusion known to other Departments of the Federal Government and discussed the findings before Senator Ribicoff's Subcommittee on Government Operations.

After concluding that Endrin poisoning caused the fish kill in the winter of 1963 and 1964, the Public Health Service, together with the States in the Lower Mississippi River Basin and other Federal agencies, set out to find the sources of Endrin polluting the waters of the Lower Mississippi and Atchafalaya Rivers. With representatives of the Department of Agriculture and the State concerned, all of the manufacturing and formulating plants in the States of Arkansas, Louisiana, Mississippi and Tennessee were visited, and a search was made for possible sources of contamination.

This, of course, you must realize, was done during the month of April. Numerous persons engaged in handling and applying Endrin to agricultural lands were interviewed. Important tributaries draining agricultural land to the Mississippi and Atchafalaya Basins were sampled for Endrin content in mud and water to determine residual effects from agricultural runoff.

The results from samples taken of mud and water from tributary streams were essentially negative. This was expected because major applications of Endrin to farm lands are not made during winter months and streams draihing farm lands were near flood stage during the period of sampling. Neither was it possible to study handling and application practices, but reports of practices that could result in water pollution were received.

Findings in the mud have been described to you, and they indicate other possible sources of Endrin pollution.

A significant source of Endrin pollution was found in the industrial sewers and other drainage from the Memphis, Tennessee, area. Water and mud deposits in Wolf River, Nonconnah Creek and Cypress Creek are heavily contaminated with Endrin and other toxic chlorinated hydrocarbons. Industrial discharges from a manufacturing plant were sampled and found to contain significant concentrations of Endrin, Dieldrin and other toxic materials. Dumps on both Wolf River and Nonconnah Creek are heavily contaminated with Endrin and other poisonous chlorinated hydrocarbons. These dumps are on the flood plains, and the polluting substances are carried directly to the Mississippi River. Mud in the old channel of Wolf River contains a large amount of Endrin and undoubtedly contributes to the pollution of the Lower Mississippi and Atchafalaya Rivers.

The State of Louisiana has asked the Public Health Service for continued technical assistance to locate the sources of Endrin and to eliminate the pollution that damages the waters of the Lower Mississippi and Atchafalaya Rivers. As resources of the Public Health Service permit, technical assistance will be provided.

CONCLUSIONS

1. The extended fish kill in the Lower Mississippi and Atchafalaya Rivers during the winter of 1963 and 1964 was caused by pollution of waters with the pesticide Endrin.

2. A source of Endrin pollution of the Mississippi and Atchafalaya Rivers has been located in the discharge of industrial waste and other drainage from Memphis, Tennessee.

3. Other sources, as yet unidentified, contribute to the concentrations of Endrin observed at New Orleans, Louisiana.

4. Endrin discharged in the Memphis, Tennessee, area, other sources of Endrin not yet identified, and possibly other pesticides and discharges of sewage and industrial wastes of many kinds, pollute the waters of the Lower Mississippi and Atchafalaya Rivers and, thereby, endanger health or welfare of persons in a State or States other than that or those in which such discharges originate. Such discharges are subject to abatement under the provisions of the Federal Water Pollution Control Act.

RECOMMENDATIONS

1. Sources of Endrin pollution from industry,

land drainage and mud deposits in the Memphis, Tennessee, area, must be brought under immediate control.

2. Other sources of Endrin must be located, measured, and brought under control, as soon as possible.

3. Additional sources of interstate pollution of the Lower Mississippi and Atchafalaya Rivers from other pollutants should be identified as rapidly as possible and appropriate control measures be taken to protect the health or welfare of residents in the States other than that in which the pollution originates.

Thank you.

MR. SVORE: Thank you.

MR. STEIN: Are there any comments or questions?

MR. JONES: One question.

Who slipped? In here it says that after all these studies, the Department of Health, Education, and Welfare has made these conclusions known to other Departments of the Federal Government and discussed the findings before Senator Ribicoff's Subcommittee of the Committee on Government Operations.

Why weren't the conclusions made known to the States at the same time? Is that an oversight in the wording here?

MR. KRAUSE: I think this conclusion that Endrin was the killer was made quite broadly at that time.

MR. JONES: After the hearing was called?

MR. KRAUSE: This was done.

MR. JONES: The conclusions were made after this hearing was called, not prior to it.

MR. KRAUSE: I believe that this conclusion was announced via a news release -- correct me if I am wrong -- on March 19th, was it?

MR. COULTER: It was made known to the State that requested the assistance, namely, Louisiana.

MR. STEIN: Pardon me. We won't have any unidentified voices from the audience. If you want to come up, identify yourself.

MR. COULTER: I have nothing else to say.

MR. STEIN: Mr. Coulter, come on up.

Mr. Coulter, who is the Deputy Chief, has been the coordinator of all this in Washington. He probably has this kind of information available.

MR. COULTER: Mr. Jones, I muttered something to Keith. It was heard out loud, and that is why I am here.

Actually, the conclusion that Endrin was the most probable cause of the fish kill in the Lower Mississippi River in 1963 and 1964 was made known to the State of Louisiana at approximately the same time it was made known to other organizations within the Department of Health, Education, and Welfare, and simultaneously with the announcement to other Departments of the Federal Government -- that is, in meetings with other Departments of the Federal Government.

At the time the findings were made known to the State of Louisiana, a conference had not been called that involved Mississippi, Tennessee and Arkansas.

MR. JONES: I am talking about the release that went to the Pittsburgh paper, dateline Washington, March the 23rd, by John W. Finney.

I happened to be in Pittsburgh that day for some reason, and he pointed out there -- of course, this is the headline that is written by the man on the desk; I know that -- "Fish Kill from Pesticides Worries Health Service," and he goes on to explain it.

That was the first I had seen. I sent a copy of this to the regional office, and, I think it was the first they had seen. This is March the 23rd.

This followed a release that went to the papers, I think, on the 17th or the 19th, or something like that, but we finally got a copy of it through the regional office, a mimeographed news release.

MR. COULTER: I am sorry, Mr. Jones. I don't follow the chronology of that account.

After the announcement was made to other Federal Departments and to the State of Louisiana, a news release was put out that received quite a bit of attention from the various Federal agencies in Washington before it was released, and, to my knowledge, none of the other 49 States were informed before that news release did go out.

MR. STEIN: Here is a copy of March 20th as received by the State of Louisiana of that press release, where they were informed.

By the way, I think that the conclusions were released to the press and, as I read the dateline in that story, and the reporter, that probably is a New York Times story syndicated.

My mother always said that "If you read it in the Times, it's true." I don't know of any better place of releasing it.

Of course, I don't think she has read anything in the New York Times but the obituaries in the last twenty years, so I guess she is safe.

(Laughter.)

There is one point that I do think should be made here, that the conclusions, as I have heard Mr. Kittrell and Dr. Mount and the other people -- I believe Dr. Mount's statement was that Endrin was the cause of the death of the fish, and I don't think there should be any semantic difference in the notion of cause or probable cause.

May I read this just to clarify it? Dr. Mount, who was the principal investigator on this said, and I quote:

> "My conclusion is that the fish kill in the winter of 1963-64 in the Lower Mississippi River was the result of Endrin poisoning,".

MR. JONES: My point is this, Murray: This is supposed to be a cooperative program, the law says, between the States and the Federal Government. Somewhere this cooperation has broken down horribly.

We have discussed this with the Jones Committee; we have discussed this with the Public Works Committee in Washington, and it is heading for very serious consequences insofar as controlling pollution in the United States is concerned.

Now, where the breakdown is, I don't know. We were talking about it outside.

Sure, you do not get 100 percent cooperation from the States. You cannot expect the cooperation that you are getting at the rate things are going. I got this release -- it was mailed on April 3rd, after seeing this in the

Pittsburgh paper. The other report I just referred to was on April 23rd. We read:

> "The alleged source is, of the two factories that manufacture Endrin, Endrin is the pesticide that has been primarily implicated in the fish kills. The factory is operated by the Velsicol Chemical Corporation at Memphis."

This is released out of Washington. This is Walter Sullivan's column, and it quotes Coulter here. It says:

> "We know it is a major contributing factor."

He added:

> "However, it is unlikely that it is the only source."

You remember, I was talking to you about it at lunch. You hedged on it too. But why do we have to read this in the press? I get calls from Atlanta every day, or every other day.

MR. STEIN: Leary, let me say this: I am saying this on the record, because I think it should be on the record. You put it on the record.

MR. JONES: I want it on the record.

MR. STEIN: 1. Water pollution control has become a big Federal function. We have over 1,200 people.

For your information, I read this stuff in the press too, and I am down the hall from these people. I don't think the world comes to an end because I get my information in the New York Times, or any other newspaper.

I think you have to recognize that when a big operation like this breaks, where we have 20 or 30 or 40 independent scientists working on this kind of story, the worst kind of thing we can do is have a suppression of this and people not talking to newspaper men.

No one here is running for election or seeking publicity, but --

MR. JONES: Oh?

(Laughter.)

MR. STEIN: Except it may be some of those companies that have worked their names into the newspapers.

MR. JONES: No.

MR. STEIN: But I don't think you see my name in the papers.

MR. JONES: No, you are not running.

MR. STEIN: That is right, but I do think that as long as we are running an organization of that kind, we are not going to suppress a scientist or our scientists or investigators.

What they are doing is a matter of public information for you, for a newspaper man, for an industry representative, when they want to come and talk to them, and I don't think there is going to be any program of repression.

Now, the difficulty with that is, when you get a big item like this or a big story like this, I think all of us, and that includes me, you and Jerry Svore here, can expect to read a good portion of this in the press. We try to keep well advised, and I don't think that any of us here in the organization has had any more advance notice of that than you did, or that they got their news from any other source than you did.

MR. JONES: Murray, I am not suggesting suppression of the press. We deal with them too. We give them all the information we get as we get it, but we have either got irresponsible reporting or irresponsible news releases for some personal use.

Now, where, I don't know. You are not running for office. I am not either. There are people running for office, though.

MR. STEIN: That may be true, but I don't think they are the people who will talk to the press.

MR. JONES: What I am getting at is this:

We have been flooded with calls from the press in regard to these releases. We called at our Atlanta office. They had no information.

Where do we affirm it? At your office or the Secretary's office?

What I am talking about is this: I know what your problem is on getting releases out. There is no way you can stop these leaks, but, by golly, you can write a release every day and get it in the mail to us -- not you, but the Secretary's office. Then the Secretary's office can start getting this stuff promptly to the States.

This puts us into an extremely embarrassing position. Then you call, not you, but somebody calls and says, "Send me data on a certain company."

Why, we don't know. The Washington office wants it. What I am talking about is this.

MR. STEIN: I sympathize with you, Leary, but let me state one thing:

If this were mechanical, as you may put it, that we prepare releases every day, this may be the case, but if we accept, as I think we have to accept, the American free enterprise system, and we have enterprising reporters working for papers like the New York Times, they go and dig out a story and find someone to talk to. That person talks to them. Then that appears in the paper without a release.

I suspect that many of the stories you are finding in the papers come there the same way, and I suspect that you, I and the rest of the people around, read them in the morning paper at the same time.

I don't have any prior information. We have looked into this, and I say again, we have looked into this very, very carefully.

I just ask you to bear with us on this kind of problem, because this is the problem of a large organization and giving independence to investigators. I recognize the problem. I wish we could do something about it.

The alternative is, to my mind, inimical to freedom of investigation and scientific inquiry, denying anyone the right to talk to the press or anyone else about the work he is doing without clearing through a maze of bureaucracy. I think the alternative, while it is a little inconvenient for us, is the thing that keeps our organization alive, that we have this freedom of inquiry and freedom of speech within the organization.

DR. NEWSOM: Mr. Chairman, I wonder if I might comment?

MR. STEIN: I'm sorry, sir. As I pointed out, this is a conference between the States and the Department of Health, Education, and Welfare.

If one of the conferees would call upon you to participate, we would be happy to have you. I am afraid we just can't open the floor to comments and questions, because if we did, we would be here for the next month, and I don't think Mr. Jones would like that.

DR. NEWSOM: I think the Chairman has ruled me out right here.

I will be permitted, I am sure, through Mr. Lafleur, but since this business of not expressing information has come up, I have something which is pertinent, and I think it should be brought to the floor at this time.

MR. STEIN: Well, I think under the procedure we have stated, you will be given a full opportunity at the proper time to bring this forward, and it will be included in the record.

DR. NEWSOM: Thank you very much.

MR. STEIN: I ask you to bear with us. If we do this for you, everyone who wants to talk at a particular time would have to be given the floor. We have to do this in an even-handed manner.

DR. NEWSOM: I appreciate this. It is a matter of the timeliness of it.

Thank you very much, and I will have an opportunity later.

MR. STEIN: All right.

MR. SVORE: Mr. Chairman, are there any more questions of Mr. Krause?

(No response.)

MR. SVORE: If not, thank you.

I do have three more Federal agencies to be heard from, and it would be nice if we could get them in.

MR. STEIN: We would like to hear them, but I do think, noticing the audience and on the basis of past experience, that we had better take a ten-minute break, and then finish with the three.

We stand recessed for ten minutes.

(Whereupon a recess was had.)

MR. STEIN: May we reconvene?

Mr. Svore?

MR. SVORE: Mr. Chairman, I would like at this time to call on Mr. E. C. Boudreaux of the Food and Drug Administration, Director of the New Orleans District.

Mr. Boudreaux.

MR. STEIN: I might point out that the people who subsequently wish to make statements should give at least one copy of their statement to the reporter. This will facilitate matters.

This is a very hard chore, taking the transcript down all day, and it will ease things if you can make a copy available to the reporter.

STATEMENT OF EDWIN C. BOUDREAUX, DIRECTOR, NEW ORLEANS DISTRICT, FOOD AND DRUG ADMINISTRATION, U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

MR. BOUDREAUX: Mr. Chairman, ladies and gentlemen:

We appreciate this opportunity to inform you of our activities in the investigations involving the recent fish kills in the lower Mississippi River and the Gulf of Mexico. This work has been conducted by our New Orleans and St. Louis District offices.

Our inspectors have been sampling commercial fish and shellfish products from the Mississippi River, areas adjacent to the river, and narby Gulf areas, for pesticide analysis for the past two months.

169 samples (109 fish, 60 shellfish) have been analyzed, others are in the process of analysis, and sampling is continuing. Products covered are buffalo, drum, carp, catfish, white perch, croaker, mullet, white trout, sheepshead, flounder, red snapper, gaspergou, oyster, crab, shrimp, and Louisiana crayfish.

Chlorinated organic residues have been detected in 106 of 109 fish samples. Analysis by gas and/or thin layer chromatography on gutted fish has revealed Endrin, Dieldrin, DDT, DDD, DDE, BHC, lindane and a residue resembling chlordane. Levels -- all on the "as-is" basis -- range from "none" in catfish from Bayou Barataria, Louisiana, to 1 part per million Endrin, 0.3 parts per million Dieldrin, and 0.3 parts per million other chlorinated residues in drum from the Lake Cocdrie, Louisiana, area.

Fifty fish samples are from the Mississippe River and its delta. Endrin findings on 49 of these range from 0 to 0.26 parts per million and Dieldrin from 0 to 0.18 parts per million. One mullet sample from the delta, 2 miles from the river, was found to contain 0.54 parts per million Endrin and 0.21 parts per million Dieldrin.

A total of 33 crab, shrimp and crayfish samples contained none or only trace residues. One sample of canned shrimp contained 0.05 parts per million Endrin, and one sample of fresh shrimp contained 0.12 parts per million Endrin. Endrin findings on 25 raw and canned oyster samples ranged from none in 7 up to 0.16 parts per million in 18.

Most of our samples have been obtained from local dealers. We are investigating fresh, frozen, and canned shellfish items which may move interstate.

No tolerances for chlorinated organic residues in fish or shellfish have been established.

Pharmacologically, our scientists believe that from the data presently available to us, humans will not be harmed by eating fish containing these levels of chlorinated organic compounds. For one item, there is the dilution factor of the rest of the diet, fish on the average making up only a minor portion of it. For another, even if these fish constituted the whole diet, the levels found are (with Endrin excepted) below the present official tolerances for other items in the diet.

The significance of the data, particularly for Endrin, is that they are a warning. If the levels in fish increase, then a potentially harmful situation may be indicated.

Our investigations are continuing. Arrangements have been made with the Public Health Service, Research and Investigations Section, Shellfish Branch, for exchange of information and cooperation with their Dauphin Island, Alabama, laboratory, on sample analysis when the need arises. We are cooperating with other Federal agencies and local officials on the problem.

MR. STEIN: Thank you, Mr. Boudreaux.

Are there any comments or questions?

(No response.)

MR. STEIN: May I ask you just one question for clarification?

MR. BOUDREAUX: Yes, sir.

MR. STEIN: With reference to your statement that no tolerance tests have been established, as I understood the Commissioner of Food and Drug, George Larrick, before the Ribicoff Committee, he indicated that the tolerance for Endrin in food was zero. In fact, if he found .05 parts per million by ordinary test methods, this was too much.

MR. BOUDREAUX: Well, the figure .05, below that represents a matter of knowing exactly what you have through the present methods, rather than that any Endrin would be considered having had a tolerance.

MR. STEIN: But you don't have a tolerance of zero for Endrin?

MR. BOUDREAUX: That is right. That is right. We are only going on the limits of analytical methods. Now, when you say something like .05 --

MR. STEIN: Well, the Commissioner of Food and Drug said that. I didn't say that.

MR. BOUDREAUX: Well, that is probably a practical working figure more than anything else.

MR. STEIN: But, in fact, the tolerance has been set at zero?

MR. BOUDREAUX: At zero. That is correct. There is no tolerance for Endrin in any products whatsoever.

MR. STEIN: All right. Thank you.

MR. JONES: One question. I didn't get the figures down of what you were finding in the fish, but it seemed like they were far above the figures that were given that will cause death in the fish.

I assume these were live fish that were brought in?

MR. BOUDREAUX: These fish were not live. They were picked off the regular market.

MR. JONES: I mean, in the market?

MR. BOUDREAUX: That is correct.

MR. JONES: Somebody got them alive. They didn't find them dead and floating, I mean.

MR. BOUDREAUX: We had no knowledge that any of these fish were dead at the time they were caught. In other words, they were the regular market line of fish.

As far as we are concerned, they have no relationship one way or the other to fish that have been killed. We don't believe that any of the fish we took were from fish kills.

MR. JONES: It will be all right for me to eat fish tonight, won't it?

MR. BOUDREAUX: Well, I would take a chance.

MR. JONES: I did last night.

MR. WOOD: I have a question.

MR. STEIN: Yes.

MR. WOOD: You said that the tolerance level of zero was set at the time when the minimum detectable concentration was what? What was the minimum detectable concentration at the time zero was set?

MR. BOUDREAUX: The minimum detected?

MR. WOOD: You have to have some basis, I believe, for setting the tolerance level of zero. This was based on the then current analytical methods.

What was your minimum detectable concentration at the time you set the zero tolerance?

MR. BOUDREAUX: I don't know, because that has been some time ago. I don't have that information with me. I'm sorry.

MR. WOOD: Thank you.

MR. STEIN: If there are no further questions, thank you very much, Mr. Boudreaux.

MR. SVORE: Mr. Chairman, I would like to call on the representative from the Department of Agriculture, Dr. Robert J. Anderson, Deputy Administrator, Agricultural Research Service, from Washington, D. C. Dr. Anderson.

STATEMENT OF ROBERT J. ANDERSON, DEPUTY ADMINISTRATOR, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

DR. ANDERSON: Thank you.

Mr. Chairman, conferees, ladies and gentlemen:

The United States Department of Agriculture is extremely appreciative of the invitation to attend your conference and participate in your discussion.

The U. S. Public Health Service report of fish kills in the Lower Mississippi River, implicating several insecticides, was of serious concern to the U. S. Department of Agriculture. Of vital concern was the question whether contamination of the river with sufficient amounts of pesticides to cause damage had resulted from the normal uses of one or more of these products for agricultural purposes or from some other source. The next question was whether registration of Endrin, Aldrin, and Dieldrin, for use on agricultural crops, should be either modified or withdrawn.

We immediately initiated measures to determine the facts of the case. A public hearing was held beginning in Washington, D. C., on April 9; continuing in Memphis, Tennessee, on April 16; and in Baton Rouge, Louisiana, on April 23. Representatives of Federal and State agencies, conservation groups, industry, colleges and universities, trade organizations and others having an interest in this matter were invited to attend and present their views.

The hearings were well attended in all three locations, and pertinent and valuable testimony was submitted. This information is now being carefully evaluated to determine what action should be taken with respect to the registration of the three pesticides concerned.

If it should be found that the cancellation of registration on Endrin, Aldrin and Dieldrin is necessary, the Department is prepared to do so. Such cancellation could well jeopardize the continued ability of the American farmer to produce the quantity and quality of food, feed, and fiber vital to our national welfare. It is imperative, therefore, that this matter be studied with extreme care and that the decision reached be based on sound judgment and evidence.

In addition, studies were initiated by this Department on April 6 to determine what part wastes from industrial plants may have played in contamination of the Mississippi. It was known that there are approximately 54 plants in the States of Tennessee, Arkansas, Mississippi and Louisiana which manufacture or formulate pesticides or

R. J. Anderson

pesticide-fertilizer mixtures.

Four two-man survey teams were established on April 7, one in each of the four above-mentioned States, consisting of a representative of the Agricultural Research Service and a representative of the Departments of Agriculture of each of the States involved. The Department of Health, Education, and Welfare was informed of our plans, and a representative of the U. S. Public Health Service joined each of the survey teams shortly after the investigations were begun. Representatives of the Food and Drug Administration also participated to some extent.

All known pesticide formulating and manufacturing concerns in Tennessee, Arkansas, Mississippi and Louisiana were visited. The teams also visited cooperage firms which purchase, clean, recondition and resell drums used for pesticide chemicals. In each case, the investigators gave special attention to practices that might result in wastes contaminated with pesticides reaching the Mississippi or its tributaries. A check list was used to insure that all practices relating to waste disposal and other pertinent matters having a bearing on the problem were fully investigated.

These investigations have been quite revealing. It was found that there are undesirable features in the waste disposal practices of most of the plants visited. The amounts of insecticides processed in some of the plants investigated are small and their physical location is such that these plants, individually, do not appear to be a major source of contamination. Taken collectively, however, they may be contributing significantly to the problem.

In other instances, conditions were observed which appear to constitute a definite hazard. For example, it was found that a cooperage company removes residual material from used drums by heating and then washing them with caustic soda. Periodically, this solution is flushed into the city sanitary sewer system. It was also found that several plants dispose of wastes at city dumps, and that as a rule these dumps are located on the river side of the levee.

Chemical wastes from processing operations in one plant have previously been placed on a city dump, adjacent to a tributary of the Mississippi.

Incidentally, this has been given quite a going over already. I hope I am not boring you with the minor details of it now.

It was learned that drums of this waste had been coming to the dump for approximately six years at the rate of about 12 drums a day. Each of these drums held an estimated 400 pounds. In other words, it appears that approximately 5,000 tons of chemical waste could have been placed on the dump over the six-year period.

The area of the dump where the waste has been deposited is periodically inundated by a river which runs into the Mississippi. In addition, water from rainfall finds its way through waste in the dump to the river and on to the Mississippi.

Probably of equal or even greater concern is the present manner in which waste from this plant is being handled. Apparently, it is going directly into an industrial sewer and eventually into the Mississippi. There appears to be no question but that this practice is contributing substantially to the contamination of the river.

It is our understanding, however, that the waste disposal system employed by this plant is in compliance with local sanitation codes.

The results of the analysis of some of the samples taken in the course of these inspections are shown in the attached appendix.

The information developed at the hearing held by the Department and from the survey of industrial plants will be most helpful in reaching a final conclusion with respect to the part agricultural uses of pesticides may have played in contamination of the waters of the Lower Mississippi or to the fish kill.

Evidence has been developed to show that there are a number of contributing factors. One of the more important of these appears to be the effect of waste entering the river from pesticide manufacturing and formulating industrial plants. Also to be considered are the effects of (1) wastes from other types of industrial plants including refining plants, paper plants, pharmaceutical plants, chemical plants, and commodity processing plants; (2) salinity in the lower reaches of the river; (3) lack of oxygen; (4) sedimentation; (5) sewage; (6) brine waste from oil and gas wells; and (7) the presence of bacteria and other disease-causing organisms.

It is significant that there have been no reports of similar fish kills in streams in other areas where Endrin and other pesticides have been used in considerable amounts over a period of years. This fact emphasizes the need for carefully studying all sources of contamination in order to determine the actual cause of the problem in the Lower Mississippi.

It was obvious from testimony, based on the considered judgment of experts, given at the U. S. Department of Agriculture hearing, that there are wide differences of opinion among individuals best qualified in fields relating to the problem. This conference, therefore, should consider all contributing factors rather than approach this important problem on a piecemeal basis.

MR. STEIN: Thank you, Dr. Anderson.

DR. ANDERSON: Mr. Reporter, this does not complete my statement. Since I prepared the statement that I have distributed here, we have some information from our laboratory results that I think should be made a part of the record, and I think should be of interest to the conferees and others.

You recall that the Public Health people referred to certain samples collected at this municipal dump of sludge material.

The sludge samples from the Hollywood dump collected on April 15 by Mr. Fairall of the U. S. Public Health Service and Mr. Barthel of the U. S. Department of Agriculture were examined in three laboratories of the U. S. Department of Agriculture.

They were first examined by paper chromatography and then thin-layer chromatography, which showed the presence of a highly soluble chlorinated hydrocarbon fraction. Total chloride determinations on these samples showed the presence of from 2 to 6 percent organic chloride.

Gas chromatography then showed peaks corresponding to what Public Health Service has referred to as X and Y, but which have tentatively been identified as **hexachloronorbornadiene** and heptachloronorbornene. This identification was confirmed by infrared analysis of thin-layer preparations from the sludge.

With the identity of X and Y established, with the data presented by Public Health Service that X and Y were present in the samples analyzed in the fish kill, with the conclusion advanced by the Public Health Service that X and Y were closely correlated with the kills, it appears at this time that agricultural uses were not involved in the kills. X and Y are intermediate components in the manufacture of Endrin, not end products to be used as pesticides. Their presence, in no way, could be attributed to agricultural practices under the criteria of cause and the supporting evidence submitted on the fish kills by the Public Health Service.

In addition, associated in the sludge samples from the Memphis area with X and Y were varying quantities of Endrin, Isodrin, Dieldrin and Aldrin, and Heptachlor. Endrin and Isodrin were present in relatively large amounts, in some cases 0.5 percent. Dieldrin present in much smaller quantity was confirmed further by infrared analysis.

Table .. Analysis of samples taken from the city dump and environs of Memphis, Tennessee, in connection with investigation of pollution of the Mississippi River with pesticides.

Sample No. and Description*	% organic chloride	p.p.m. Pesticide found Aldrin	Dieldrin	Endrin	Isodrin	Heptachlor
1 Sludge hauled to dump from Cypress Creek. Sampled at dump	3.8	200	340	5500	5600	800
2 Do (same pile)	2.6	240	360	6100	6600	900
3 Do (another pile)	2.8	240	340	4700	5900	2100
4 Do Do	2.2	120	200	3500	4300	1400
5 Do (4th pile)	6.1	(balance of sample lost)				
6 Do (5th pile)	3.4	240	290	4700	6300	1400
7 Red solid from drum	74			Indeterminant		
8 Same (another drum)	71			Indeterminant		
9 Same (Do)	70			Indeterminant		
14 Scum from water in	-	<.1	<.1	<.5	<.2	<.1
17 Drum label isodrin	25	trace	trace	172,000	40,600	-
18 Another drum as 17	17	Do	Do	140,000	69,600	-
19 Drum containing grey mud-like material	none found	<.4	<.4	<.4	<.4	<.4
20 Water from trench	-	<.1	<.1	<.5	<.2	<.1
21 Sludge from Cypress Creek taken in the creek	3.8	150	240	2900	4800	130
22 Do	3.0	270	360	5900	8200	140
22A Black solid from dum	none found	<.4	<.4	<.4	<.4	<.4

DR. ANDERSON: Thank you.

MR. STEIN: Thank you.

Would you wait just a moment, Dr. Anderson?

Are there any comments or questions?

(No response.)

MR. STEIN: I just have a comment. I think our statements are very, very close, but I do think that Mr. Kittrell and Dr. Breidenbach, as I understood their statements, indicated that there were additional sources of Endrin coming into the river from below Vicksburg or below the West Memphis station. I think Mr. Kittrell made some indications of an estimate of that, how much was coming possibly from the Memphis area, and how much was coming below it.

I note that you have indicated several things that should be looked into, and you also indicate that one of the most important of the sources seems to be the effect of waste entering the river from pesticide manufacturing and formulating industrial plants.

I wonder if, in addition to the seven you mention -- and there seems to be a pretty broad spectrum -- that it might not be appropriate also to look into the possibility that Endrin might run off from farm lands, and it also might come into water courses from indifferent application, such as perhaps airplanes putting it on at the wrong time, or perhaps seeding a tributary stream from above, as well as the fields.

If we are proposing as comprehensive an examination of the problem as that, perhaps these other two points should be included in the examination.

DR. ANDERSON: I think you asked two questions there, one specifically in which you made reference to possible sources of contamination or Endrin entering into the Mississippi below the Memphis area.

I am not denying that that could not happen, but I have to refer, I believe -- I don't have the page, but it appears to me that one of your people reported this morning that on the sampling that took place from around April 13th on, in which they found evidence of Endrin and some of the other pesticides in the main stream of the Mississippi, that their findings on the Arkansas, the Red River, Black River and the Atchafalaya, were negative to Endrin.

It appears to me at this time of the year, when you are having a terrific runoff from agricultural lands due to flooding, that there is bound to be a considerable amount of sedimentation moving into the river tributaries of the Mississippi.

Now the other point about the Department looking into these other causes; We are quite mindful of our responsibility in this area, and have now under way initiated a definite monitoring program to determine what amount of Endrin and other pesticides may be entering into the water systems of this country. This will not only include the Mississippi Delta area, but will include the total United States, because we are just as anxious as anyone else to know what happens to these chemicals.

We will run analyses on the soils at different times of the year. We will run analyses on the runoffs from the crop lands. We will monitor the meat and the milk in those areas, and at the same time record the pesticides use history of the area that we are monitoring.

We think this is only one small fraction of the total job to be done.

We also are developing guidelines for practices to be followed by aerial applicators, guidelines to be followed by the farm applicators, in how they can best clean and care for their equipment, how they can, by neutralizing in some manner, dispose of left-over pesticides to prevent their entering into the streams and causing some degree of contamination.

MR. STEIN: Dr. Anderson, I think your remarks are well appreciated, but I think we should clarify the record on one point here.

I think your statement was that these negative results of sampling below Memphis might have indicated Endrin in view of the high flows and the mud brought down.

I am reading from Mr. Krause's statement, the Chief of our Technical Services Branch. He says the results from samples taken of mud and water from tributary streams were essentially negative. This was expected because major applications of Endrin to farm lands are not made during winter months, and streams draining farm lands were near flood stage during the period of sampling.

In other words, I think it is the opinion of the scientists in the Department of Health, Education, and Welfare, that a meaningful determination might have to be made during periods of application, and you would not expect to find Endrin in those streams at the time they took the samples.

DR. ANDERSON: We are planning to look into this matter of runoffs during the growing and application season, but following the principle that these hydrocarbons attach themselves to soil particles, then you have a high amount of sedimentation runoff during the spring rains, and you would expect, according to our scientists, to have some runoff of the pesticides by soil sedimentation during the spring rains.

MR. STEIN: I take it you would not object, though, to the investigation including possible runoff from farmland and possible indifferent application?

DR. ANDERSON: Mr. Chairman, I would like to repeat myself the third time now, that we are planning to investigate that ourselves, and we certainly would welcome any cooperation from any other agency that might wish to join us.

MR. STEIN: Thank you.

MR. SVORE: Mr. Chairman, I would like to call on a representative from the Department of the Interior, Dr. Johnson, Assistant Director of the Bureau of Sport Fisheries and Wildlife, Department of the Interior, Washington, D. C.

DR. JOHNSON: May I go off the record just a moment right at the start, please, Mr. Chairman?

MR. STEIN: Yes.

(Discussion off the record.)

STATEMENT OF DR. R. E. JOHNSON, ASSISTANT DIRECTOR, BUREAU OF SPORT FISHERIES AND WILDLIFE, UNITED STATES DEPARTMENT OF THE INTERIOR, WASHINGTON, D. C.

DR. JOHNSON: I should mention for the health of the stenotypist here, the first two speakers will have papers for your use, but neither the Bureau of Commercial Fisheries nor the Bureau of Sport Fisheries and Wildlife has a public relations organization within it. We have no handouts.

(Laughter.)

The first participant represents the Bureau of Commercial Fisheries within the U. S. Fish and Wildlife Service, Mr. Jack Lowe of the Gulf Bureau's research station in Florida.

His story will be confined primarily to the pesticide story as it affects the commercial fishery resources, including shellfish.

STATEMENT OF JACK LOWE, BUREAU OF COMMERCIAL FISHERIES, UNITED STATES DEPARTMENT OF THE INTERIOR, FLORIDA

MR. LOWE: Mr. Chairman and ladies and gentlemen:

I have a statement prepared by Dr. Philip Butler, Coordinator of the Bureau of Commercial Fisheries. This is primarily a summary of our investigations of Aldrin, Dieldrin and Endrin.

The application of agricultural chemicals and other pesticides to farms and forest land has contaminated lakes and rivers. The chemical and biological stability of some of these chemicals has resulted in their transport and concentration at remote sites. Inevitably, some of them are being carried into estuarine areas, but to what extent and how long they will persist is still not known. Their use should be restricted until we have better information.

The estuarine environment is extremely important to commercial fishery resources. It serves as a nursery and growing area for many important species, and is the permanent habitat of other food species such as oysters and crabs. Shrimp and menhaden, providing respectively our most valuable and largest commercial harvests, spend a large part of their life cycle in estuarine waters. They and the estuarine oyster and clam resources account for about 50 percent of total U. S. fishery landings and about 33 percent of the landed value.

The pesticide program has devoted a major part of its early research to determinations of the acute toxicity of these chemicals under controlled laboratory conditions. The test conditions for the different groups of bioassay animals differ, since different criteria of toxicity must be used. In general, the animals are exposed continuously in flowing sea water to a graded series of pesticide concentrations. Observations are made for periods ranging from 4 to 96 hours.

Phytoplankton

The microscopic plants of the sea are the essential link in the conversion of solar energy into food for more complex marine animals. Chemicals interfering with phytoplankton growth and reproduction could seriously interfere with the production of commercial fishery harvests. One measure of the well-being of phytoplankton is the rate at which a sample incorporates inorganic carbon molecules into its cellular matrix. This may be measured precisely using radioatively labeled C^{14} under constant light conditions. By mixing known amounts of C^{14} with two samples of phytoplankton, one of which contains a known concentration of pesticide, it is possible to measure whether and how much the pesticide interferes with growth in a given period of time. Using this decrease in growth, or decrease in carbon fixation, as a standard the relative toxicities of a series of pesticides may be compared.

Crustacea

Much of our concern about pesticide pollution of the marine environment continues to stem from the fact that shrimp, our most valuable fisheries crop, are crustacean members of the arthropod phylum. Most pesticides have been especially selected for their ability to kill terrestrial members of this group, and for this reason we would suspect that shrimp would be especially sensitive. Juvenile shrimp spend their first growing season in estuaries near the source of land drainage, thus the effects of pesticides on these young stages are examined with particular interest.

Some pesticides paralyze shrimp and other crustacea with which they come into contact rather than kill, so that the criterion for toxicity with this group is the effective concentration causing paralysis or death to half of the sample within a stated period, usually 24 hours. Pesticides dissolved in acetone are metered into flowing sea water aquaria to maintain the desired concentration.

Mollusks

Clams and oysters are of particular interest because of their known ability to store in their tissues high concentrations of chemicals that exist in only trace amounts in the surrounding sea water. Since most mollusks normally flourish in estuarine waters, they may be particularly sensitive to chemicals washed in from the adjacent river basin. Mollusks, however, are able to close their valves and protect themselves from toxic substances in the environment. Tests to evaluate their sensitivity to pesticides must be conducted at sublethal concentrations, and we find that as with phytoplankton, growth is a sensitive index.

Individual, juvenile oysters grow at quite uniform rates under similar conditions and it is possible to compare shell deposition (growth) in a control group of oysters with the average amount of shell deposited by oysters exposed to various concentrations of a test chemical. The effect of a series of pesticides on oysters then can be expressed as EC_{50}, the effective concentration causing a 50 percent decrease in growth in experimental as compared to control oysters during a definite period, 96 hours.

Fish

The sensitivity of estuarine fishes to pesticides varies unpredictably with the species, but, in general, the younger fish are most quickly affected. Consequently, juveniles are used in the reported tests. Tests are conducted in flowing sea water, stock solutions of pesticides are made up in acetone and fish exposed to four or more dilutions of the pesticide.

In the following tabulation, acute toxicity data are presented for Aldrin, Dieldrin, and Endrin. These chlorinated hydrocarbons are closely related and are among the most toxic chemicals that have been tested in our program. The data that are presented are for tests conducted at summer water temperatures. In cold water, animals are only slight more resistant and the chemicals are essentially just as toxic. Tests are now underway to to learn the effects of these chemicals on developing molluscan larvae, their storage in living oysters, and their effects on juvenile marine fish exposed for long periods to sublethal concentrations.

Considering the sensitivity of shrimp to Endrin levels of 0.6 parts per billion in brief laboratory experiments, and the ability of shrimp to concentrate and store pesticide residues at levels many times as great as the concentration in the environment, we feel that environmental levels above 0.06 parts per billion should be viewed with alarm.

Effects of Certain Pesticides on Estuarine Organisms

Bioassay	Aldrin	Dieldrin	Endrin
Data in Percentages:			
Algae			
Phytoplankton - percent decrease in carbon fixation caused by 1000.0 ppb	84.6	84.8	46.0
Data in Parts Per Billion:			
Crustacea			
Shrimp - amount causing paralysis or death in 24 hours	0.6	25.0	0.6
Blue Crap - amount causing paralysis or death in 24 hours	50.0	550.0	100.0
Mollusks			
Oysters - amount causing 50 percent decrease in growth in 96 hours	25.0	34.0	33.0
Fish			
Juvenile Spot - amount causing 50 percent mortality in 24 hours	8.2	5.5	4.4
Juvenile Mullet - amount causing 50 percent mortality in 24 hours	3.1	7.8	2.6

MR. LOWE: Thank you, Mr. Chairman.

MR. STEIN: I thank you.

Are there any comments or questions?

(No response.)

MR. STEIN: Before we go on, I have been asked to make an announcement here, just in case any of you should get desperate and want to leave this fascinating meeting.

We are going to reconvene tomorrow at 8:30. The people like their work so much and feel there are no distractions in this town, and they should be able to get up bright and early tomorrow. Anyway, we hope to finish tomorrow and will make a valiant effort to do so. This should give us a leg up.

Dr. Johnson?

DR. JOHNSON: The second participant, this one representing the Bureau of Sport Fisheries and Wildlife within the United States Fish and Wildlife Service, Department of the Interior, has something to contribute on the menhaden kill of early November in 1963. He is Dr. Fred P. Meyer, parasitologist, Fish Farming Experimental Station, Stuttgart, Arkansas.

STATEMENT OF DR. FRED P. MEYER, PARASITOLOGIST, FISH FARMING EXPERIMENTAL STATION, STUTTGART, ARKANSAS

DR. MEYER: Mr. Chairman, conferees and ladies and gentlemen:

On November 4, 1963, a telephone call was received from Dr. Richard T. Gregg (Louisiana Pollution Control Commission) and Mr. William H. Herke (Acting Project Leader, Cooperative Fishery Research Unit, Louisiana State University) at Baton Rouge, Louisiana, concerning a major fish kill which was underway on the Mississippi River and in the Atchafalaya Basin. Their specific concern was whether or not the mortalities might be due to an epizootic of hemorrhagic septicemia, a disease caused by a bacterium known as *Aeromonas liquefaciens.* In order to reach such a conclusion, it is necessary to culture the pathogen and conduct a series of studies of its physical and biochemical characteristics. The decision was therefore made to visit the area of the kill to collect material for bacterial cultures.

On November 5, 1963, I flew to Baton Rouge. That night I necropsied numerous dead mullet (Mugil cephalus) and refrigerated specimens of several other species in search of possible clues to the cause of death. At the conclusion of these examinations, no conclusive evidence as to the cause of death had been found and a decision was made to visit the area in which the kill was underway. Further discussions were held with Dr. Gregg, Mr. Robert Lafleur (Pollution Control Commission), Mr. Herke, and Dr. R. J. Muney of the Fisheries Department of Louisiana State University relative to the extent, past and current history of such kills, species and sizes of fish affected, and other pertinent information such as the tidal zone and what type of studies had already been performed.

On November 6, 1963, I spent the day in the company of Dr. Gregg and Mr. Herke in the vicinity of Raphael Pass, Pass a Loutre, and several tidal pools. Using skiffs equipped with outboard motors we collected moribund fish of the following species:

Blue catfish	*Ictalurus furcatus*
Mullet	*Mugil cephalus*
Menhaden	*Brevoortia* sp.
Gizzard shad	*Dorosoma cepedianum*

and material was taken from the liver and/or kidneys for the inoculation of Trypticase Soy Agar (TSA) for the possible culture of pathogenic bacteria. Lesions, parasites, and other abnormal manifestations were recorded, if present.

F. P. Meyer

During the day, an estimated one million fish (my estimate) were observed dead along the shore of Raphael Pass and floating in the various other areas visited. By far the greatest percentage, the major species affected was menhaden. Throughout the day, many fish, particularly menhaden, were observed exhibiting erratic swimming patterns. When disturbed, these fish often swam convulsively in tight circles or skittered along the surface. This activity usually terminated in a spasm during which the fish floated aimlessly showing tremors of the fins. After a period of approximately 60 seconds, these fish seemingly regained their equilibrium and swam off in what appeared to be normal behavior. No lesions were evident on the fish examined during the day. However, several types of parasites were observed. These included a larval nematode of the genus Centracaecum in the kidney of one mullet. This parasite normally matures in fish-eating birds so its presence in a mullet would be a normal finding. Encysted parasites in the flesh of one blue catfish proved to be metacarcariae (larval stages) of a fluke with which I was unfamiliar. These, too, would constitute a normal finding. Several monogenetic flukes (parasitic worms) were noted on the gills of some of the mehhaden and gizzard shad but these were not present in sufficient numbers to cause mortality. None of the above parasites was considered to be a primary factor in the kill which was underway.

Dead fish were apparent over the entire delta area visited, but most of the carcasses were observed in Raphael Pass, where the wind -- and it might have been motorboats, I am told -- had piled the fish in windrows along the shore for miles. In other passes, the current was carrying the dead fish out to sea.

The evening of November 6, 1963, was spent in a laboratory examining specimens which had been collected from the Mississippi River in the vicinity of Baton Rouge by a second team of men. This collection included several drum (_Aplodinotus_ _grunniens_), a small mouth buffalo (_Ictiobus bubalus_) estimated to exceed 30 pounds in weight, and a blue catfish weighing approximately 20 pounds. Hemorrhagic areas covered the entire body of the buffalo but were cutaneous in nature. These bloodshot areas gave the entire fish a red color unlike any condition I have ever observed. No hemorrhagic areas were noted in the muscles but the kidneys appeared highly inflamed. The blue catfish and drum were normal in color and other appearances. When collected, all fish had exhibited behavior similar to that observed for fish collected on the delta areas. Material for the inoculation of TSA medium was taken from these fish for bacteriological study.

On November 7, 1963, I returned to Stuttgart, Arkansas, where bacteria isolated from the fish collected on the previous day were transferred to new media in the disease laboratory at the Fish Farming Experimental Station. After re-isolation and the establishment of pure cultures, studies were made of their morphological and biochemical characteristics. In these studies, each organism was compared with those taken from other fish in the area of kill and with known fish pathogens. Tests were made to determine if Aeromonas liquefaciens or other suspected pathogens might be present.

When the data from the various cultures were compared, it was noted that eleven of the 20 isolates proved to be negative. Of the remaining nine, at least five different organisms were apparent. None of the fish was infected with Aeromonas liquefaciens. Of the organisms encountered, only the culture from the smallmouth buffalo proved to be a known fish pathogen. This organism was identified as belonging to the genus Pseudomonas which has frequently been implicated in diseases of warm water fishes. Its presence in one fish has little significance, however, since it is common for fish to harbor lowgrade infections without any outward symptoms of disease. Cultures are readily isolated on TSA from such carriers as well as those which might be harboring an active infection. The condition manifested by the buffalo incidentally was not typical of a bacterial infection.

Checks of preserved material carried back to the laboratory and of speciments sent later by Mr. Herke failed to reveal the presence of a parasite-induced epizootic. Parasites observed on preserved material were essentially the same as had been encountered in the field. Protozoan parasites were not found.

The accumulated data from my visit indicate several relevant facts. These include:

1. An apparent random distribution of areas in which the kill was underway.
2. The kill was gradual and persistent rather than an abrupt phenomenon.
3. Affected fish did not exhibit external lesions.
4. Affected fish exhibited erratic swimming patterns with frequent convulsive spasms prior to death.
5. No bacterial infection could be found which was common to the affected fish involved in the kill.

6. No parasitic infestation could be found to which a kill of these proportions might be attributed.

When these factors are considered singly and collectively, I do not feel that a bacterial or parasitic disease was the primary contributor to the extensive kill I observed on the Lower Mississippi River Delta on November 5, 6 and 7, 1963.

MR. STEIN: Thank you, sir.

Are there any comments or questions?

(No response.)

MR. STEIN: Dr. Johnson?

DR. JOHNSON: I need not emphasize the point to the conferees or to the ladies and gentlemen present that the United States Fish and Wildlife Service is the Federal agency responsible for the conservation and preservation of wildlife in the United States and for the retention of their environments.

In this work we are joined by all of the State conservation departments as well.

This matter in the matter of pollution of interstate waters is of interest to us not only for that reason, but, more specifically, because the Fish and Wildlife Service was directed by public law 85-582 to evaluate the effects of pesticides on wildlife and to assist in the development of chemicals and techniques to minimize wildlife losses.

Our work in connection with the reported mortality of fishes in the Lower Mississippi River has been confined mainly, as you have just heard, to studies of the possible environment of bacteria viruses and parasites.

In addition to the work done by Dr. Meyer, Dr. S. F. Snieszko, Director of Eastern Fish Disease Laboratory in West Virginia, received a small shipment of fish from Dr. Tarzwell of the Robert A. Taft Engineering Center.in Cincinnati, Ohio, early in January of 1964.

Dr. Snieszko and his staff made a microbiological examination of the specimens to detect any levels of infection that might have caused or contributed to the death of the fish. All of his results were negative. He reported that to Dr. Tarzwell on January 9th.

Going back a little further, on February 2, 1961, Dr. Snieszko in West Virginia corresponded with Mr. Robert Lafleur of the Division of Water Control here in Baton Rouge about the reported die-off of fish in November of 1960. Dr. Snieszko stated that he had received the frozen fish from Mr. Lafleur. Their bacteriological examination and isolation of bacteria was difficult, however, because the specimens had not been cared for very well in transit.

At this point, I should clarify one sentence from Dr. Snieszko's letter of February 2 to Mr. Lafleur, which has led to confusion in hearings held up to this time.

MR. STEIN: Would you mind giving me the date on that, just for the record?

DR. JOHNSON: February 2, 1961. Is that the date you need?

MR. STEIN: Yes.

DR. JOHNSON: Dr. Snieszko's letter reads this way:

> "Our examination for the presence of Aeromonas liquefaciens and similar bacteria are causing this disease."

Those of us who know Dr. Snieszko realize that while his command of English is perfect, his command of the accent is not so good, and teamed with a stenographer who might not have interpreted him correctly, there was a misunderstanding.

Dr. Snieszko recognizes this as an incomplete sentence, and on his file copy of the letter of February 2, 1961, to Mr. Lafleur, he adds two final words, "was negative." He did not find bacteria capable of causing mortality in that shipment.

R. E. Johnson

Again, on January 17, 1961, Mr. Lyle Pettijohn, Fishery Biologist at the Eastern Fish Disease Laboratory, Leetown, West Virginia, wrote to Mr. Lafleur on the results of examining frozen adult catfish and gar sent from Louisiana. He stated that a microscopic examination of the specimens did not disclose the presence of any bacterial infection, that internal parasites occurred in the catfish, but not in significant numbers, and that the skin of catfish bore patches of an unknown oily substance.

You always find more things than you can understand in fish population.

Therefore, based on what we have seen, our staff holds the opinion that if bacteria, viruses or parasites had been present in sufficient numbers to contribute to the death of fish, they would have been detected.

I quote again the statistics given to you by Dr. Mount on Page 29 of the record today, showing in his case one thing, but the statistics apply equally well to our examination of fishes for the determination of bacterial involvement.

Now, to this negative evidence must be added the additional negative points that the fish, both dead and moribund, gave no sign of dying from abrupt temperature changes, from deficient oxygen, from starvation, from exposure to heavy metal or exposure to excessive phenol concentrations.

On the other hand, other diagnostic evidence indicates that chemicals might well have been involved. The spasms and tremors of the dying fish reported by Dr. Meyer match those described in controlled laboratory and field tests. The distended air bladders and inflated intestinal tracts also reported have been associated with mortalities caused by absorption of DDT metabolites from the glyceride fats and oils of fish flesh and fish eggs.

I repeat that because it may answer a question that came up here earlier. These were not in the proteins, but in the glyceride fats. There is where they were short. The reported hemorrhages in the cardiac region of the fish match observations that have been made in the laboratory on fish exposed to concentrations.

I think the Bureau of Commercial Fisheries and the Bureau of Sport Fisheries and Wildlife want to make it perfectly clear that we do lack absolute proof that the dead and moribund fish reported on the day and observed by our people succumbed to the effects of chemicals foreign to their bodies and their environment, and we do not have evidence sufficient to submit pertaining to the source of any of the chemicals mentioned today.

Those reports have been covered full well by other agencies. The full proof is not present in our organization at the present time. It could be sought in the near future as a cooperative State and Federal venture. It would require, of course, carefully planned monitoring of the fish, as well as of the environments. The job is within reason and certainly it is feasible now.

Twenty years have passed since the Fish and Wildlife Service first began to study the effects of the generally beneficial chemical DDT, on fish and wildlife, and ten years have passed since we picked up the threads of investigation on Aldrin, Dieldrin and Endrin. In those years, many other chemical groups have been studied as well. We call these chemicals "beneficial chemicals" when judicially used, and we have studied those.

In those years, several fundamental characteristics and several vital relationships between the chemicals and fish and wildlife have been established, and there is a strong likelihood again that many of these characteristics and relationships have combined in the Mississippi and other rivers to create the situations that have been discussed here today.

I don't mean to imply that we know it all by a long shot, but I should be very much surprised if many new unknown principles in the relationships of chemicals to fish and wildlife appear from the Mississippi River studies here.

We have learned so much in the past. For example, the persistence of certain chemicals, particularly hydrocarbons in soil and water, has been documented repeatedly. Their drift in air over unexpected distance has been documented by radioactive tags. Their runoff into surface waters, whether we are talking about farm ponds, rivers, or oceans, has been documented in many places, and they are more than theoretical possibilities. The uptake of these chemicals by vegetables, by invertebrates and fishes, and their concentration in animal bodies, in amounts much greater than any measured in the environment, is demonstrated repeatedly.

One of the best and most recent examples was the finding of DDT in the body of a live seagull at Green Bay, Wisconsin, in an amount approaching 2,700 parts per million. The fish on which he had fed had about 1 part per million in their bodies, and the bottom of the Green Bay had a barely detectable trace.

This concentration effect in living organisms was one of the amazing and intriguing things that are showing up.

I repeat, that gull was alive. We have found it in fish many times, with other chemicals.

The lack of evident effect upon the fishes or birds of this concentration until some stress or some physiological hard time besets the organism, even with a lag time of years, is also noted. The adverse effects of chemicals on fish, some chemicals on fish and wildlife living some distance from the point at which the chemicals were introduced, are also documented. I am talking about chronic effects and not acute effects. The acute effects are the quick ones, the easy ones to document. The chronic effects are the ones that take longer to appear and are harder to determine.

For example, you have to go through two or three generations of birds sometimes to find the effects of the doses fed to the original parents in the first place, especially when the succeeding generations are continually exposed to chemical pesticides. The effects sometimes do not show up until the second or third generation.

A point was mentioned in a question today about the synergistic effect of detergents on certain chemicals, it being hinted at, but I can't say we have clear evidence of a relationship yet. Of course, with the gradual fading out of ABS from the washing powders and the appearance of a more biodegradable substance, perhaps this relationship may disappear too. I don't know.

All of these points have to be kept in mind, plus the points that additional pollution from industrial wastage or spillage or effluent from treatment plants, or drainage from storm sewers, has to be kept in mind. But we do know the basic framework, and we do know certain possibilities exist. I have just mentioned a few.

In conclusion, I think we feel most strongly that whatever material now found as residues in many species of fish and wildlife, or the sources from which they come, or the extent and locale of animal mortality, the United States Fish and Wildlife Service is deeply concerned, and not only because great areas of environments and habitat have apparently been made unsuitable and fishes have died, but also because of the serious implication that the water used by these living natural resources of ours is less than clean enough to allow them to survive. We are concerned certainly with the certainty that birds and fish in other areas similar to the Lower Mississippi River will not be faced with the same situation of unclean water. This certainly can be reduced in time only by the most judicious use of chemical insecticides with due regard for their persistence and their spread and their broad spectrum.

(The prepared statement of Dr. Johnson is as follows:

Mr. Chairman, I am R. E. Johnson, Assistant Director for Sport Fisheries in the Bureau of Sport Fisheries and Wildlife, Department of the Interior. I presently work in the Interior Building, Washington, D. C., and reside in Arlington, Virginia.

The Bureau of Sport Fisheries and Wildlife is the Federal agency chiefly responsible for the conservation and preservation of the living natural resources of our nation as well as the retention of their environments. This conference in the matter of pollution of interstate waters is of interest to the Bureau more specifically because the U. S. Fish and Wildlife Service, of which the Bureau is a part, was directed by Public Law 85-582 to evaluate the effects of pesticides on wildlife and to assist in the development of chemicals and techniques to minimize wildlife losses.

Our work in connection with the reported mortality of fishes in the Lower Mississippi River has been confined to studies of possible involvement of bacteria, viruses, and parasites in the fish deaths. Fish from the mortalities of 1960-61 and 1963-64 were examined by Dr. S. F. Snieszko at our Eastern Fish Disease Laboratory.

Fish from the latter kill were examined in the field and in the Fish Farming Experimental Station by Dr. Fred P. Meyer. Dr. Meyer will report separately upon his observations and culture tests.

Early in January 1964, Dr. S. F. Snieszko, Director of the Eastern Fish Disease Laboratory at Leetown, West Virginia, received a small shipment of fish from Dr. Clarence Tarzwell of the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Responding to Dr. Tarzwell's request, Dr. Snieszko and his staff made a microbiological examination of the specimens to detect any levels of infection that might have caused or contributed to death of the fish. All examinations of the fish for parasites in vital organs gave negative results. All other tests, including the study of stained smears under the microscope and the routine culturing and isolation of bacteria on nutrient media, failed to show the presence of viral or bacterial forms that could have been implicated in the fish deaths. Dr. Snieszko reported on January 9, 1964, to Dr. Tarzwell in Cincinnati that all tests were negative.

Dr. Snieszko corresponded with Mr. Robert Lafleur of the Division of Water Pollution Control in Baton Rouge on February 2, 1961, about the reported die-off of fish in November 1960. He stated that the frozen fish submitted by

Mr. Lafleur was not entirely satisfactory for bacteriological examination and that isolation of bacteria was difficult. One sentence from Dr. Snieszko's letter of February 2 has led to confusion because it reads, "Our examination for the presence of Aeromonas liquefaciens and similar bacteria are causing this disease." Dr. Snieszko recognizes this as an incomplete sentence and has written on his file copy two final words, "was negative." He did not find bacteria capable of causing this mortality. His intent on February 2, 1961, was clear in the last paragraph in the same letter when he asks for subcultures if Mr. Lafleur "or anyone from your group, isolate bacteria which could be in general classified as Pseugomonads..."

On January 17, 1961, Mr. Lyle Pettijohn, Fishery Biologist at the Eastern Fish Disease Laboratory, Leetown, West Virginia, wrote to Mr. Lafleur on the results of examining frozen adult catfish and gar sent from Louisiana. He stated that a microscopic examination of the specimens did not disclose the presence of any bacterial infection, that internal parasites were present in the catfish but not in significant numbers, and that the skin of three catfish bore patches of an unknown oily substance.

Our staff holds the opinion, based on the activities described above and by Dr. Meyer in a separate statement, that if bacteria, viruses, or parasites had been present in sufficient numbers to contribute to the deaths of fish, they would have been detected in even a smaller sample than was examined. To this negative evidence must be added the additional negative points that the fish, both dead and moribund, gave no sign of dying from abrupt temperature change, deficient oxygen, starvation, exposure to heavy metals, or to excessive phenol concentrations.

On the other hand, other evidence indicates that chemicals might well have been involved. The spasms and tremors of the dying fish reported by Dr. Meyer match those described in controlled laboratory and field tests. The distended air bladders and inflated intestinal tracts also reported have been associated with mortalities caused by absorption of DDT metabolites from the glyceride fats and oils of fish flesh and eggs. The reported hemorrhages in the cardiac region are also significant.

The Bureau lacks absolute proof that the dead and moribund fish observed by Dr. Meyer and Mr. Herke on November 5, and the preserved specimens sent to Dr. Snieszko in 1961 and 1964, succumbed to the effects of chemicals foreign to their bodies and their environment. Though proof is not present, it could be obtained in the future as a cooperative State-Federal venture. The job is within reason and is

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technically feasible.

Twenty years have passed since the effects of the first widely-used and generally beneficial chemical, DDT, upon fish and wildlife were noted by biologists. Ten years have passed since the effects of Aldrin, Dieldrin, and Endrin were first noted. Many other chemical groups, beneficial when properly used, have also been studied. Several fundamental characteristics and several vital relationships to fish and wildlife have been established. There is a strong likelihood that many of these characteristics and relationships have combined in the Mississippi and other rivers to create the situations we discuss today.

The persistence of certain chemicals in soil and water, their drift in air over unexpected distances as documented by radioactive tags, and their runoff into surface waters are more than theoretical possibilities. The uptake of chemicals by vegetation, invertebrate organisms, and fishes, and their concentration in animal bodies in amounts much greater than any measured in the environment, is demonstrated repeatedly. The lack of evident effect upon the fishes or birds of this concentration, until stresses or physiological hard times beset the organism, even with a lag time of years, is known. Adverse effects upon fish and wildlife living some distance from the point of use are not new. And, of course, the traditional types of pollution are present always, either in the form of industrial wastage and spillage, effluent from treatment plants, or drainage from storm sewers. All of these points should be kept in mind as the conditions in the Mississippi are evaluated.

Whatever the materials now found as residues in many species of fish and wildlife, or the sources from which they come, or the extent and locale of animal mortalities, the Bureau of Sport Fisheries and Wildlife is deeply concerned; not only because great areas of environment and habitat have apparently been made unsuitable and fishes have died, but also because of the serious implication that the water used by these living natural resources is less than clean enough to allow them to survive. And concerned, finally, with the certainty that bird and fish in other areas similar to the Lower Mississippi are and will be faced with the same threat of unclean water.)

MR. STEIN: Thank you, Dr. Johnson.

Are there any comments or questions?

Mr. Lafleur?

MR. LAFLEUR: Dr. Johnson, I think I understood you, and correct me if I am in error, that you had documented the detection of a toxiphene. Am I correct in that?

DR. JOHNSON: Not in this one instance here, but in other parts of the country, yes.

MR. LAFLEUR: What was the methodology involved?

DR. JOHNSON: I can't tell you that, but there is a man in the audience who might be able to -- no. He gives me a nod and he says he is not able to.

MR. LAFLEUR: Thank you.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: If not, thank you for your persistence and your good temper.

We will reconvene at 8:30 tomorrow morning.

(Whereupon, at 6:25 p.m., the conference was recessed until 8:30 a.m. of the next day, May 6, 1964.)

ERRATUM:

The next consecutive volume (Volume III) begins with page 449.